PB-230 838

HUMAN ECOLOGY AND THE METROPOLITAN ENVIRONMENT: ENVIRONMENTAL HAZARDS IN LOS ANGELES

Maurice D. Van Arsdol, Jr., et al

University of Southern California
Los Angeles, California

1 April 1966

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National Center for Air Pollution Control

Final Report
Air Pollution Control Division
U. S. Public Health Service Contract PH [illegible]

April [illegible]

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April 1, 1966

PREFACE

This monograph portrays the social nature of environmental hazards in an American metropolis. It is concerned with air pollution in Los Angeles and Orange Counties. This hazard is compared with airplane noise, brush fires, floods, and slides; to indicate the manner in which air pollution is related to urban population, social organization and technology. Our work provides a framework for the analysis of environmental hazards, and explores their meaning for urban life.

The study on which this report is based was undertaken by the University of Southern California Department of Sociology and Anthropology Population Research Laboratory. Major support for the research was provided by Air Pollution Control Division, U.S. Public Health Service Contract PH 86-62-163. Other aspects of a larger study of intrametropolitan residential mobility, in Los Angeles and Orange Counties, of which the environmental hazard study is a part, were facilitated by a grant from the John Randolph and Dora Haynes Foundation of Los Angeles. Data for certain portions of an analysis of relations between

environmental hazards and Los Angeles County urban settlement patterns were obtained under National Science Foundation Grant No. 69452 to the Population Research Laboratory. Additional aspects of the research were funded directly by the University of Southern California.

Advice and encouragement were received from Dr. Leslie Chambers and Dr. Martin H. Neumeyer of the University of Southern California; Dr. Arthur G. Coons and Dr. Gordon S. Watkins of the Haynes Foundation; and from Dr. Nahum Z. Medalia, Dr. Lester Goldner, and Dr. William C. Loring of the Air Pollution Control Division, U.S. Public Health Service. We are especially grateful to Dr. Loring, who has been instrumental in planning and implementing this work. Dr. Raymond J. Jessen of the University of California at Los Angeles and Dr. John Takeshita of the University of Michigan were sampling consultants for the research. Mr. James R. Taylor of the Los Angeles County Air Pollution Control District and Mr. Charles Dougan of the Orange County Air Pollution Control District provided information concerning air pollution patterns in the metropolis. Data concerning aircraft noise were made available by supervisory or command personnel of the Los Angeles International Airport, Hughes Airport, and the El Toro Marine Corps Air Base.

Information on brush fires was obtained from published reports of the Pacific Fire Rating Bureau. The staff of the Los Angeles and Orange County Engineer's Offices specified earth slide areas, and flood data were provided by officials of the Los Angeles and the Orange County Flood Control Districts. Mr. John McQuiston, now of the Population Research Laboratory, made available State of California Division of Highways Metropolitan Region Transportation Study information concerning land use in Los Angeles and Orange Counties.

Interview procedures and the editing, coding, and tabulating of interview data were supervised by Mrs. Aili E. Larson, now of the University of Southern California Rossmoor-Cortese Institute for the Study of Retirement and Aging. Dr. Edgar W. Butler, now of the University of North Carolina at Chapel Hill, made important contributions to the study design and provided technical supervision for the interview operations. Mrs. Bharati Karia assisted with editing, coding, and tabulating of interview data. Mr. Neal E. Cutler, now of Northwestern University, and Mr. Leo A. Schuerman, of the Population Research Laboratory, provided computer analyses of the data. Mr. Cutler was responsible for initial drafts of portions of Chapters V and VI. The charts and graphs were delineated by Miss Suzanne Searle. A critical evaluation of the manuscript and suggestions for data analyses were given by Dr. Lee Burns, of the University of California at Los Angeles. Portions of Chapters III and IV of this monograph have been previously published by Maurice D. Van Arsdol, Jr., as "Metropolitan Growth and Environmental Hazards: An Illustrative Case," United Nations World Population Conference, Belgrade Yugoslavia, 1965, Paper A.8/V/E/89, and reprinted in Ekistics, Volume 21, Number 122 (January, 1966). Sections of Chapter V have been published by us as "Reality and the Perception of Environmental Hazards," Journal of Health and Human Behavior, Winter, 1964. Finally, we are most indebted to our spouses--Marian, Jack, and Renay--who gave help and encouragement at every stage of the research. Our dependence upon the cooperation and assistance of our friends and colleagues does not lessen our responsibility for any defects of analysis and interpretation.

Man has always been concerned with the hazards of his habitat. He has adapted to avalanches, blizzards, droughts, earthquakes, fog, frost, hailstorms, heat waves, hurricanes, lightning, tidal waves, tornadoes, typhoons, and volcanic eruptions. Continued urban population growth in the United States has made other environmental hazards a part of our urban scene. These hazards include air pollution, airplane noise, brush and forest fires, floods, and slides. Organized attempts to deal with these hazards may result in new systems of political and economic organization for making optimum use of our air, earth, and water. Research on the causes and consequences of urban environmental hazards has just begun. Some progress has been achieved in hazard abatement but few efforts have been made to prevent urban environmental hazards. This report is an initial attempt to describe the interrelations of urban environmental hazards and the social life of the metropolis. A cautious interpretation of this work is congruent with the tentative nature of our findings.

Maurice D. Van Arsdol, Jr.
Francesca Alexander
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April 1, 1966

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CHAPTER I

SUMMARY

The Urban Environment

Worldwide urbanization is quickening the pace at which man alters his habitat. Environmental consequences of the works of man are now evident throughout the earth. Future population increases and concentrations in metropolitan areas will intensify human modifications of air, land, and water. This monograph describes environmental hazards in a major metropolitan area of the United States and some of their effects upon urban life. The focus is on air pollution in Los Angeles and Orange Counties. This hazard is then contrasted with brush fires, airplane noise, floods, and slides--to show how air pollution is related to urban population, social organization, and technology.

Resource utilization reflects man's beliefs and desires.[1] Some men tame inhospitable environments, and others tap resources in a manner which is not admissible in terms of wider value systems or not economically gainful.[2]

Nowhere are these rules more apparent than in the emerging mixtures of rural and urban environments now accompanying the birth of the "megalopolis" in the United States.[3] Than 2,000 years after the rulers of the Peloponnesus founded and named what was to be a new city state in Greece,[4] at least fourteen supercities are coalescing along the federal freeway system, including one such agglomeration in Southern California. Future population growth will likely result in the transformation of megalopolitan settlement patterns into "ecumenopolis" as population saturation is approached during the next century.[5] This climax could result in intensive human utilization of all inhabitable areas of this nation.

Inside our young megalopolises are now found all past features of the cityscape, as well as new urban functions and forms. These include commercial, governmental, industrial, and transportation centers; slums and suburbs; and the aging housing stock accumulated from unplanned urban growth during the past century. Continued population aggregation will mean that urban settlements will grow upward through high rise construction. Suburbanization or future outward expansion will result in more urban encroachment upon rural areas. The megalopolis now encompasses many functions formerly non-urban in nature. These include retirement, resort, and other specialized residential communities; as well as agricultural and other extractive industry, forests, wildlife preserves, and recreation areas. As residential and non-residential competition for space increases, the megalopolis will experience dense settlement in new residential communities. Innovations in the economics, organization and technology of land development will decrease the time required to create urban communities from non-urban land. Unrelieved demands for public space will intensify pressures upon vacant space, and generate innovations in settlement forms and environmental uses.

Future conversions of significant portions of the 1,904 million acre land area of the continental United States to urban, metropolitan, and megalopolitan use are expected to increase urban land area from 23 million acres in 1960 to more than 71 million acres by the end of this century.[6] This change will be accomplished largely through the withdrawal of more cropland from agricultural use and applications of new land development strategies to deserts, swamps, and unmanaged forest lands adjacent to existing urban complexes. Continued urbanization will intensify demands for more transportation land, recreation sites, water management areas, and wildlife preserves. Initial urban development will lead to geophysical and biotic changes including brush and forest fires, floods and slides. Expansions of technology will accentuate air pollution, airplane noise, and water pollution. To the extent that urbanization follows a megalopolitan pattern, concentrated population pressures are likely to increase hazard levels. Environmental alterations within and adjacent to urban areas will render economically and socially useless some land forms that are now in gainful use and will be associated with new value systems pertaining to land management, and new systems of political and economic organization for environmental utilization.

In the nineteenth century United States there were major concerns with the effects of the city upon the lives of our people. This focus led to the rise of urban institutions, which dealt with physical and mental health, crime and delinquency, housing, transportation, commerce, and education. More recently, national interests have focused on environmental situations associated with continued urbanization and metropolitan and megalopolitan development. These have included: maintenance of the air, fauna, flora, land and water which comprise our basic physical resources. Further alterations of metropolitan areas and their related hinterlands will lead to new economic, health and social problems, and the possible loss of the rural cultural heritage that has been interwoven with the fabric of American life.

Ecological Systems and Environmental Hazards

We view environmental hazards from the perspective of human ecology, which deals with interrelations of environmental, social and biotic aspects of human communities as a unified system.[7] These interrelations include the geophysical and biological environment, as well as human population, social organization, and technology. Technological and organizational limits on population settlement and activity densities, for example, mean that rapid metropolitan population growth increases the need for urban land. As land is placed in urban use in low density metropolitan segments, disturbances may be activated in the natural environment. These changes can intensify such "natural" or economic hazards as brush fires, floods, and earth slides. Continued urbanization may lead to "artificial" or health hazards, including air pollution and airplane noise. Whether or not hazards are perceived by populations or monitored by agencies depends partially on the "symbolic environments" of urban people and the types of social organization that bear on the urban habitat. Hazards affect contrasting urban sites, and the meanings and reactions they invoke may vary by different populations.

Our concern is with environmental hazards as a part of the ecological system of the Los Angeles Standard Metropolitan Statistical Area from 1940 to 1960. Environmental hazards, population, social organization, and technology, are here described as parts of a single system bounded by the political limits of the metropolis.[8] Basic outlines of changes in the system are structured by relations operating at the level of the total metropolis, which have different effects on contrasting urban locations. Within the system, however, there is room for personal choice. Actions relevant to environmental hazards appear to depend on meanings which perceived hazards have for populations. Before hazards are perceived, or action taken in regard to them, they must be identified. Hazard identification requires knowing how and when to recognize them, and recognition in turn, depends on the kind of world that people structure for themselves, or on their "symbolic environments." An ecological description of urban environmental hazards must then specify how environmental perceptions are integrated with social organization, and how organization and technology are related to environmental modifications.

The utility of this study depends upon the typicality of Los Angeles as an American metropolis. While Los Angeles is often regarded as a unique development, comparisons with other metropolises show that Los Angeles is different in that population growth is more rapid here than in most other large communities in the United States; thus, social and environmental problems accompanying urbanization are magnified. Los Angeles is like other metropolitan centers in terms of its spatial groupings of neighborhood social characteristics, mobility rates, and social organization. It does represent new changes, due to development coterminous with that of the automobile, but, at the same time, follows past trends of other metropolitan areas. The similarities of Los Angeles to other United States metropolises and its developing megalopolitan character, make Los Angeles a satisfactory locale for research on environmental hazards.

The Study Plan

An ecological approach to environmental hazards required access to geophysical, technological, and population data systems in the Los Angeles area, as well as information pertaining to symbolic environments as perceived by Angelenos. The study made use of four kinds of data. First, governmental and business organizations provided information concerning the spatial distribution of air pollution, airplane noise, brush fires, floods, and slides in 1960, as well as the pattern of air pollution in 1950. All air pollution measurements were based on oxidant levels, which indicate one form of photochemical air pollution in Los Angeles. Second, 1960 land use data for Los Angeles and Orange County neighborhoods were obtained from local government surveys conducted under technical supervision of the State of California Division of Highways. Third, changes in the internal organization of the population of Los Angeles were described by U. S. Bureau of the Census data for the 1940, 1950, and 1960 decennial censuses. Fourth, interview information concerning an areal probability sample of all adult housing unit residents of the metropolitan area in 1961, and a subsequent sample interviewed in 1962, were used to stand for environmental perceptions of the population of the metropolis. Data from these disparate systems were merged to facilitate comparisons of the effects of neighborhood characteristics upon perceptions and actions with reference to the environment. Details of the study design and procedures are given in subsequent chapters concerned with specific problems of the structure and influence of environmental hazards upon metropolitan life. Despite controls in the collection, processing, and analysis of data, the reader is advised to view our conclusions with caution. Environmental hazard data were collected under field conditions, without laboratory accuracy. The land use information is only as reliable as the surveys from which it was derived. Our census and interview data are subject to sampling and response and recording errors. The merging of the different data systems sacrifices accuracy of interpretation. On the basis of this research, we cannot infer that certain subareas within the metropolis are more or less desirable places in which to live.

Conclusions

Our theme is that man's use of technology leads to environmental hazards that play a significant role in human utilization of urban land and the development of the metropolis. Future studies of metropolitan growth and expansion must consider environmental hazards as part of a total ecological system, if they are to have theoretical relevance and practical utility. While our findings are tentative, certain consistencies are nevertheless evident. The research suggests the following generalizations concerning the relations of urban environmental hazards to social organization and the culture of the city:

1. Environmental hazards are a population problem which reflects interaction within a metropolitan ecological system. They are associated with urban population increases, and are pervasive within Los Angeles. Air pollution or smog--one of the most basic hazards to American urban metabolism--affects more than one-half of the residential population and one-seventh of the land area of Los Angeles and Orange Counties combined. Aircraft noise characterizes one-fifth of the residential population and more than one-seventh of the land area. High population densities in these smog and noise areas and the channeling of fire, floods, and slides into other metropolitan segments mean that a majority of residents of the metropolis are exposed to one or more hazards. There are few residential areas within commuting distance of current employment centers which are not subjected to one or more potentially serious environmental hazards. To the extent that hazards accompany urbanization, population redistribution away from affected

sites will not continue to reduce population exposure to hazards. Future population increases will augment the rate at which environmental changes occur, and tend to increase the size of affected sites and the intensity of hazards. Given constant air supplies, for example, these conditions will prevail unless per capita emissions of air pollution decrease at a more rapid rate than population increases. We cannot escape the consequences of our use of urban land.

2. The artificial and health hazards of smog and air traffic noise in Los Angeles County are often concentrated in centrally located areas of older housing and perhaps represent a culmination of unplanned urban development. Mature neighborhoods are often characterized by heavily traveled freeway and secondary road networks, and by the accumulation of residues of industrial and commercial activity. Within Orange County, however, the relations of urban development to smog and air traffic noise are not as clear. Here the constrictions of topography and pressures for space may not now be so great as to generate such hazards within the older areas. Data are not available from which to generalize the Los Angeles County findings to different metropolises, but limited information suggests that some of these findings may hold for air pollution.

3. The connection of urban settlement patterns with environmental hazards suggests a corollary lead. With the exception of initial construction and federal urban renewal or community based redevelopment, the aging of our urban housing stock often represents a pattern of physical deterioration associated with a further down-grading of the social environment. Smog, in Los Angeles, is often a characteristic of low rent, low home value, and low ethnic status neighborhoods, whose residents are also exposed to such social hazards as delinquency, crime, and family disorganization. In this respect, oxidant, or smog, as measured here, may reflect an "over-utilization" or portions of the urban environment, based on present levels of automobile based intrametropolitan transportation.

4. While differential urbanization within the metropolis is related to the spatial distribution of environmental hazards, there is need to determine whether hazards play a role in mobilizing growth away from affected intraurban sites. Given the mountainous topography of the area, and a freeway system that intersects in the older urban cone, an examination was made of factors accounting for decreased smog exposure of residential population in Los Angeles County from 1950 to 1960. It was found that changing smog exposure is largely due to population

redistribution and not to population shifts from smog to non-smog areas at the same stage of urbanization and at the same approximate commuting distance from downtown Los Angeles. Population densities, however, are increasing more rapidly in non-smog than in smog neighborhoods at the same stage of the housing cycle. Contrasting urban populations, however, apparently have differential opportunities to escape smog. Smog is a function of urban development, and the growth of the metropolis is associated with population redistribution away from affected sites. There was no clear evidence that smog is associated with the downgrading of urban neighborhoods.

5. Positive relations were found between the physical presence of hazards in neighborhoods and their perception. Excluding brush fires, a smaller portion of the Los Angeles and Orange County population perceives hazards than live in neighborhoods with hazards present. Smog was the most frequently perceived hazard in residence areas, and was the most crucial hazard for perception, whether respondents lived in hazard areas or not. These relations, however, do not hold true for all population segments exposed to or not exposed to the hazards.

6. When attention was focused on the symbolic environments of population aggregates, it was assumed that

a phenomenon is perceived more readily when it is expected than when it is unanticipated. Comparisons between residents of areas with highly publicized environmental hazards and those of areas with hazards less publicized, suggested that expectations influence hazard perceptions. Populations perceiving hazards tended to be male, have higher levels of education, have past experience in urban rather than in rural environments, and have lived in areas which have been publicized as having unclean air. These differences may indicate that hazard perceivers have shared communications channels. It may be that hazards are seen in terms of assumptions that urban populations make about the immediate spatial contexts of their lives. In this respect, the selective perception of environmental hazards can be incorporated into a pre-existing experiential organization, which is related to urban experience and training.

7. An association between the presence of hazards and individual action is found when certain conditions are met, such as knowing what one can effectively do about them. Although individuals may wish to complain about impure air they frequently do not since they believe that their action may have little or no effect. Movement to areas with clean air, however, may be implemented. The mobility rate in

areas characterized by smog, holding constant the degree of urbanization, is greater in smog than in non-smog areas.

In conclusion, environmental hazards are ubiquitous in Los Angeles and Orange Counties. They are apparently generated by the patterns of technology and social organization utilized to convert land to urban use, and by increasing intensities of urban settlement and land use. Given the present limits on urban settlement imposed by the economics of land development, mountainous topography, and a freeway system that intersects in the Los Angeles plain, populations are redistributing away from affected urban sites, as a consequence of normal processes of city growth. This redistribution may lead to under-utilization of certain neighborhoods. Urban residents perceive environmental hazards--apprently to the extent that their symbolic environments coincide with geophysical and biotic conditions. Hazard perception is related to education and experiences within an urban context where hazards may be expected to be present. There is a lack of awareness among metropolitan populations concerning ways of dealing with hazards, but individual action may be taken by moving from air pollution areas. Environmental hazards may make for dislocations in neighborhood development; restrict commercial activities; be associated through redistribution processes with under-utilization of the environment and place important strains on the ecological system of the metropolis.

These conclusions have briefly described the social nature of environmental hazards in Los Angeles and Orange Counties. Subsequent chapters further describe the hazards and their effects upon urban life. Chapter II considers human ecology and the urban environment, including the social significance of environmental hazards. It provides an ecological framework for the hazard study, and shows the typicality of Los Angeles as a focus of research. The character of environmental hazards in Los Angeles and Orange Counties is the focus of Chapter III. Topics covered include a description of the metropolitan site, and patterns and convergences of hazards within the metropolis. Chapter IV describes ecological structure and population redistribution with respect to hazards. Subjects include environmental hazards and the urban housing cycle, the case of smog and population redistribution, and smog and the filtering down of urban population and housing.

Chapters V and VI are concerned with hazard perception and their implications for behavior. Reality and the perception of hazards are the focus of Chapter V, which describes the role of the symbolic environment in hazard perception, reality-perception relations and urban social structure, and the characteristics of hazard perceivers and non-perceivers. Chapter VI describes behavior and environmental hazards, including environmental hazard perception and individual action in relation to smog and residential mobility.

Implications for Action

Action programs based on hypotheses rather than data are undertaken at risk. The tentative nature of the conclusions concerning Los Angeles should lead to caution in implementing the Clean Air Act. Our only measure of air pollution is an oxidant index which is sensitive to the automobile related photochemical nature of air pollution in Los Angeles. Other measures of impure air could have been used. The fact that a number of other metropolitan areas have oxidant problems does not necessarily mean that the relations of photochemical pollution and social organization will be the same as in Los Angeles. We have yet to clearly describe the role of air pollution in the social and physical downgrading of urban neighborhoods, or to specify the social and economic costs associated with continued air pollution or with air pollution control. Unless we can make such estimates, there is no way of measuring the effects of abatement programs, or of planning for local, state, and federal investments in such programs. Our conclusions, nevertheless, would appear to have some broad applications to air pollution control programs, particularly in the Los Angeles area. These applications are not advanced as prescriptions for action, but as guidelines in public policy formation.

1. Environmental hazards are a population problem associated with changes in metropolitan ecological systems. Population growth in the United States will continue to be translated into metropolitan aggregation, expansion of the urban habitat, and increases in the intensity and scope of hazards. Increments of urban population will nullify hazard control programs geared to conceptions of urban America as it is today. Long range planning, of the type developed for the water resources of the West, will be necessary to insure that air pollution, and other urban hazards, do not reach and remain at unacceptable levels in many metropolitan areas.

2. Residential population redistribution away from areas with impure air to oxidant free neighborhoods accompanies redistribution to newer areas at the outskirts of metropolitan Los Angeles. Nevertheless, settlement densiti are increasing more rapidly in smog than non-smog areas at

the same stage of the housing cycle. It is important to determine, for other metropolitan areas, if air pollution is a factor in population redistribution. If this is the case, under-utilization of affected sites could mean that expenditures for urban development--including water supply, sewage, school and street systems--will not be amortized at usual rates. Cost estimates for such a lack of amortization would be of significance to private enterprise as well as to local, state, and the federal government. It may well be that programs designed to control air pollution would be more effective if any costs of potential under-utilization of affected sites are determined, and become public knowledge.

3. Air hazards are most likely to be present in areas characterized by social hazards of the urban scene, and must be added to the other urban ills of older neighborhoods. Public health programs designed to deal with depressed segments of the Los Angeles area, should in some cases, also include a consideration of air pollution.

4. Illusion and the perception of environmental hazards are disparate, yet subtly intertwined. Locations of air pollution recording devices are partially determined by population perceptions. This suggests that the recorded levels of air pollution, to some extent, may reflect air

pollution awareness in urban neighborhoods. Programs designed to increase public awareness of air pollution are thus an important component of air hazard monitoring programs.

5. Compared with air traffic noise, brush fires, earth slides, and flood, air pollution was the most frequently perceived hazard in Los Angeles and Orange Counties. Nevertheless, only 39 per cent of the population living in oxidant areas perceived smog. Further analysis of complaints concerning air pollution indicated that populations apparently are unaware of how to take action with respect to air pollution issues. Air pollution has a long history, yet the majority of contemporary Angelenos do not regard air pollution as vital to their welfare. Most human concerns with environmental dangers stem from catastrophic hazards, which are readily apparent in their effects. The less spectacular and more pervasive annoyances of the urban scene, while not so dramatic in their results, outweigh the losses of life and property associated with such traumatic upheavals. Unless this fact is fully communicated to, and internalized by our population, hazard abatement programs are unlikely to have major results. Until Americans comprehend the dangers of the urban habitat, it will not be

possible to initiate organizational changes that are necessary for environmental control. In this respect community information programs that facilitate air pollution perception and pinpoint modes of action may have important effects. Populations that are most aware of air pollution are male, have high levels of education, share past experiences in an urban environment, and may be in the same communications channels. Such populations may well be an effective focal point for air pollution control programs.

6. Hazard control rests as much on effective social organization as on the technology of abatement and prevention. The control of air pollution and other hazards requires simultaneous planned changes in population, social organization, technology, and the environment; and poses more complex issues than the urban renewal of the aging cores of our central cities. The United Kingdom experience with air pollution in a limited environment has shown that a measure of abatement can be obtained by the consolidation of control in the national government. As our metropolises spill over state boundaries and coalesce into megalopolitan areas, new governmental mechanisms will be required for hazard control.

In conclusion, air pollution is but one

environmental component of a complex metropolitan ecological system. This monograph describes how air pollution and several other environmental hazards are interrelated within a single metropolis. Future research on environmental hazards is likely to emphasize a systems approach, which deals with populational and organizational aspects of the properties and functions of the total ecological system.[9] Action programs concerned with only one aspect of the system--such as air pollution--are likely to have limited success. For example, a shift in the basis of intrametropolitan transportation systems from the internal combustion engine to mass rapid transit or to individual electrical vehicles, would place major strains on social and economic institutions and lead to different types of environmental hazards. Present systems concerns with environmental hazards tend not to include organizational and populational determinants and consequences.[10] Unless these determinants and consequences are considered as an integrated part of the total ecological system, action programs designed to cope with air pollution are likely to have few lasting effects. The problem is not air pollution, per se, impure air is but one condition leading to, or resulting from, metropolitan ecological changes. In this context, we believe that air pollution is a proper focus for continued federal research and action programs only when there are corollary programs designed to deal with interrelated populational, organizational, and technological components of the metropolis.

Footnotes

Chapter I

[1] Walter Firey, Man, Mind and Land: A Theory of Resources Use (New York: The Free Press of Glencoe, Illinois, 1960).

[2] Ibid., pp. 243-52.

[3] Jean Gottman, Megalopolis: The Urbanized Northeastern Seaboard of the United States (New York: The Twentieth Century Fund, 1961).

[4] Ibid.

[5] "The City of the Future," Ekistics, XX, No. 116 (July, 1955), 4-51.

[6] Lee Taylor and Arthur R. Jones, Jr., Rural Life and Urbanized Society (New York: Oxford University Press, 1964), pp. 162-63.

[7] Otis Dudley Duncan, "Social Organization and the Ecosystem," Handbook of Modern Sociology, ed. Robert E. L. Faris (Chicago: Rand McNally and Company, 1964), pp. 37-82.

[8] Orange County was removed from the Los Angeles Standard Metropolitan Statistical Area subsequent to the 1960 Census of Population and Housing, and was not part of the metropolitan area in 1950. The Los Angeles metropolis, unless otherwise indicated, is here defined as including both Los Angeles and Orange Counties.

[9] For an example of a systems consideration of environmental hazards that deals with environmental components of the ecological complex, see: Committee on Pollution, Waste Management and Control: A Report to the Federal Council for Science and Technology (Washington, D.C.: National Academy of Sciences National Research Council, 1966). This report, while considering public policy and institutional arrangements for waste management, gives little emphasis to the relations of population, social organization, and population perceptions to the recording of hazards.

[10] Ibid.

CHAPTER II

HUMAN ECOLOGY AND THE METROPOLITAN ENVIRONMENT

Introduction

Concerns with human alterations of the American habitat have led to recent recordings of effects of urbanization upon the air, earth, and water resources of metropolitan areas.[1] Hazard monitoring systems have been established for impure air, airplane noise, brush and forest fires, radiation, poor soils for drainage, polluted water supplies, and overloaded sewage systems.[2] Some of these hazards are "natural," in the sense that they are attenuated by the conversion of rural or unused land to urban uses. Others are "artificial," and perhaps represent a residue of continued urbanization within metropolitan areas. The incidence and prevalence of environmental hazards varies from one United States metropolis to another.

Major natural hazards in Los Angeles--brush fires, floods, and earth slides--are primarily economic in their effects.[3] On the other hand, the artificial hazards of air pollution and airplane noise may be a danger to public health, and result in economic losses.[4] In the United States and other nations, hazard abatement is now a matter of public and private concern.[5] Little attention, however, has been given to how hazards are related to or influenced by metropolitan social organization and value systems.[6] An understanding of these relations is necessary for hazard control and prevention. The concern of this research is with air pollution in Los Angeles and Orange Counties, which is contrasted with other hazards in order to provide insight into the nature of impure air. Environmental hazards are then compared with metropolitan population, social organization, and technology. For those interested in clearing the air and in reducing hazard levels, this monograph provides information that may be of practical use.

Beyond the practical implications of this work, there is an attempt to indicate how considerations of metropolitan social organization can be integrated with those of the metropolitan environment. While social organization is rightly the focus of sociological endeavors, sociologists have often neglected the interaction of the environment and social organization. This work indicates how urbanizing populations modify their habitats and the manner in which environmental modifications are reflected in the perceptions and behaviors of population aggregates and individuals. For the sociological enterprise to have practical utility and conceptual meaning, sociologists must consider environmental as well as individual and aggregate aspects of human organization as part of a single system. This chapter briefly examines the significance of environmental hazards in American metropolitan life. An ecological frame of reference for the study of environmental hazards is then described, and evidence is presented to indicate that Los Angeles is an appropriate locale for environmental hazard research.

The Significance of Environmental Hazards

In the nineteenth century, it became apparent to statemen, government officials, businessmen, academicians, and citizens alike that the American urban condition was a major factor structuring the destiny of our nation. The concern with the urban world was initially focused on *the city*.[7] City problems were often seen as at variance with those of the remainder of the United States. From the beginnings of the public health movement[8] and initial concerns with the housing conditions of our people,[9] the interest has been broadened to include a mapping of factors associated with population adjustment to many facets of urban life. The first such concerns in the twentieth century were with the social disorganization leading to failures of our major urban institutions and impeding the lives of individuals.[10]

Within the past forty years, community, state, regional and federal action has been taken with respect to the above difficulties. Action programs have concentrated on the hazards of living conditions reflected by sub-standard housing and community disorganization characteristic of older sections of our cities. Personal and family disorganization has been approached by the mental health movement; economic disorganization by public assistance programs and by economic and social planning; juvenile delinquency and adult crime by behavior prevention and control projects; education by systems of community, state and federal support; and physical blight by urban renewal. It is now apparent, however, that these urban difficulties are interrelated. Maladjustments within one sphere of urban life often have damaging repercussions in another,[11] and the human urban condition cannot be modified without taking into account the urban habitat.[12] A recent shift away from problems of the city to those of the metropolis and megalopolis has led to a consideration of additional hazards associated with the more intensive use of air, water, and land in the expanding settlements of our nation.[13] Underlying this concern is a growing understanding that metropolitan areas constitute living systems--"complex structures of matter maintained by energy imputs."[14] Such systems include the conversion of biotic and geophysical materials present in the metropolitan habitat, and information processes pertaining to the organization of sustenance activity.[15] Metabolic processes--including provisions for waste disposal, air and water--are necessary for continued operation of the system.[16] A social requirement for system maintenance is that resources be utilized in an organized and integrated manner. Fragmented resource utilization will eventually disrupt the metabolism of the metropolis and lead to environmental hazards and social disorganization.

Some environmental hazards are not as graphic in their nature as are images reflected from the shabby debris of urbanization, including delapidated tenemants and rooming houses, auto junk yards, grimy manufacturing lofts, and bleak parking lots. The new hazards include air pollution, jet aircraft noise, and the destruction of wildlife preserves and park areas associated with freeway construction. Airplane noise and air pollution are related to physiological and psychological stress. Moreover, air pollution of the photochemical variety affects rubber, fabrics, and dyes: decreases human visibility and destroys the plant life which conveys the vision of nature that we hope to maintain along with the urban way of life. Other environmental hazards, including brush fires, floods, and earth slides, while not so ubiquitous, are sometimes associated with drastic changes in the urban habitat. It would appear, however, that these more elusive and recent hazards play a role in the structuring of urban life that warrants investigation.

A Frame of Reference for the Study of Environmental Hazards

The metropolis and megalopolis cannot be understood in a framework where urban life is seen as influenced solely by social organization. Organizational, behavioral and cultural approaches to urban life cannot stand alone, but must be integrated with considerations of the urban physical fabric as springing from the efforts of the social organization to adjust to urban life. We have therefore approached environmental hazards from the perspective of human ecology.

Five decades ago, the early human ecologists developed a frame of reference based on a model taken from the biological sciences. They incorporated concepts used by Charles Darwin as well as those used by plant and animal ecologists in order to explain interrelations between different species and their environments.[17] When an attempt was made to pursue the role of man in Darwin's web of life, attention was focused on the urban world. Here it was believed that competitive relations were generated when changes took place in the nature of economic behavior that led to population aggregations in urban areas, and expansion of urban environments and hinterlands. Competitive processes were seen as necessary for the development of urban subareas with characteristic land uses, populations, social organizations, values, and behavior patterns. These neighborhoods included areas of affluence, skid roads, slums, immigrant sections, suburbs, and middle class areas. Tendencies toward community segregation also presumably made for the differentiation of subcenters for various types of commercial, economic, governmental, and industrial functions.

From a contemporary ecological perspective human populations are viewed as adjusting to their physical and social environments. Obtaining adjustment requires the use of technologies that provide sustenance and influence the social organization of sustenance-producing activities.[18] Human ecology is thus concerned with the interrelations of population, organization, technology, and environment.[19] In modern American metropolises the organization of sustenance activities is becoming concentrated in the sphere of consumer services with a de-emphasis on the production activities formerly found in the cores of central cities. The technology of automobile based intrametropolitan transportation has freed urban functions, including housing, commerce, and industry, from locations near air, rail, and water termini. Many urban activities can now be carried out in a number of locations, and decentralization of economic activity has facilitated population expansion away from central cities.

The above changes are coupled with rapid population growth in emerging megalopolitan complexes and increased rates of urban technological change. Growth concentrations in suburbs and satellite centers are associated with increases in levels of several environmental hazards. Pressures from air travellers for rapid automotive access to central cities mean that the suburbanward movement of airports has not kept pace with residential population expansion. Since the late 1950's, noisy jet propelled commercial aircraft, the increasing scope of aircraft landing and circulating patterns, increasing air traffic, and the relatively more central locations of airports have increased exposures of urban populations to airplane noise. Air pollution is becoming a major metropolitan problem, due to residues of smoke producing industries in central cities, constricted urban airsheds, funding of the federal highway program, new organization and technology for highway and freeway construction, the suburbanward movement of population, and increased use of the automobile. Recent advances in earth moving technology have made possible hillside residential construction in segments of metropolitan areas considered to be unusable twenty years ago. Brush fires, and earth and mud slides have resulted from the subsequent conversion of marginal land to urban use, the peopling of this land, lack of development regulations, and consequent interruptions in the natural environment. Populated lowland urban segments have experienced flooding to the extent that the expansion of metropolitan drainage and sewage systems has not kept pace with population growth.

Human population, organization, technology, and environment constitute an interrelated system. The present conceptual level of human ecology, however, does not lead to a complete theory of environmental hazards. Concepts of human ecology are used here as a frame of reference or a way of viewing hazards. From our perspective, environmental hazards comprise a partial basis of explanation for the development of metropolitan or megalopolitan areas. They may further be related to population perceptions and evaluations of housing and neighborhood environments, which may help to polarize decisions to move from or to stay at current places of residence. Within this context, air pollution, airplane noise, brush fires, floods, and earth slides are not seen as necessary instigators of urban change. Such hazards, however, may constitute sufficient conditions for change once certain necessary alterations have occurred in urban social organization and technology.

Environmental characteristics and other aspects of urban change may operate on different ecological levels. At the level of neighborhood analysis, it is possible to compare changes in internal patterns of metropolitan areas as related to modifications of population and organization along with intrusions of environmental hazards. Summary characteristics of neighborhood populations may or may not have counterpart characteristics descriptive of the individuals comprising the population of such subareas. On the personal level, reactions of populations to their urban situations may be seen as determined by social psychological as well as by "objective" characteristics. Furthermore, the illusion created by the "symbolic environment"[20] based on meanings given to environmental events may have as much influence on individual behavior and urban social organization as the characteristics of the physical environment itself.

Our view of urban life is that the general outlines of urban behavior are laid down by relations between population, organization, technology and environment that operate at the level of the metropolis or megalopolis as a whole. These relations have differential effects upon various urban locations and their characteristic populations. For persons within the system, however, there is room for individual choice. For example, an increase in the freeway mileage of an urban region as a whole may facilitate the building of mass produced suburbs at far corners of a metropolis, which increases automobile traffic and result in an increase in impure air in older metropolitan neighborhoods. Population reactions to a subsequent rise in air pollution levels in the central city may vary systematically by station in life, health level, and by neighborhood of residence. Decisions to move away from a central city place of residence are often activated by changes in the family life cycle that require more bedrooms. Ranges of choices of possible new neighborhoods in which to live are structured by relations between population growth and available housing, and the economics of the housing market, as well as by individual resources. Final choices of housing units may be made in terms of evaluations of perceived neighborhood environments. A clear consideration of the operating levels of these behavioral determinants is essential to any description of the social results of environmental hazards. This work describes the relative influence on behavior toward hazards by the characteristics of the metropolis as a whole, the aggregate characteristics of population of urban neighborhoods, and the individual social-demographic and social-psychological characteristics of metropolitan residents.

Los Angeles as a "Typical" Metropolis

Given its size and the variety of life styles represented by such communities as suburbs, downtown apartment areas, beach cities, and retirement villages, it is not surprising that many Americans regard Los Angeles as an atypical center.[21] In viewing the Los Angeles and Orange County scene, it is tempting to equate sixty mile commuter

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round trips and the glamour of backyard swimming pools with unique urban development.

The facade of Los Angeles, however, obscures population and environment trends that are coming to characterize the remainder of urban America. For example, in addition to Southern California, photochemical air pollution is now reportedly present in Alabama, Arizona, the District of Columbia, Hawaii, Indiana, Kentucky, Maryland, Missouri, New Jersey, Ohio, Pennsylvania, Utah, and West Virginia.[22] Los Angeles was the first metropolitan area to grow up with the automobile, and has led in the decentralization of metropolitan population, manufacturing, and retail trade outside of the central city. The Los Angeles mode of branch store retailing, single family ranch houses, and drive-in services are now typical urban phenomena.[23] Los Angeles, however, has always been like other metropolitan centers in terms of its neighborhood social characteristics.[24] It has the same kinds of apartment house areas, zones of workingmen's homes, and suburbs as are found elsewhere.[25] Comparisons between Los Angeles and other metropolises indicate that what is different about Los Angeles is that population growth is currently greater than in many other metropolitan communities and the urban phenomena accompanying growth are thus magnified.[26] The high residential mobility rates of Los Angeles, for example, are a function of high rates of in-migration.[27] Los Angeles is a budding megalopolis emerging from a series of Southern California metropolitan areas. The history of Los Angeles parallels that of the internal combustion engine, but the patterns of neighborhood development here are the same as in the rest of urban America. Legitimate analyses and comparisons can be made here with respect to other metropolitan centers in the United States.

Summary

Population increases and the birth of megalopolis in different sections of our nation have led to a number of new social and environmental problems. Increased conversion of land to urban uses has been associated with urban development. Initial urbanization has intensified natural or economic hazards of brush fires, floods, and earth slides. More intensive land use and increasing population densities result in the intrusion of artificial or health hazards, including smog and aircraft noise, into more urbanized segments of metropolitan complexes. A frame of reference for relating environmental hazards to urban social organization was drawn from the field of human ecology. Human populations are here portrayed as adapting to their physical and social environments while utilizing technologies that contribute to sustenance producing activities. This adjustment has social psychological ramifications, as populations define the physical and social environment is defined in terms of their symbolic environments. Los Angeles is an appropriate site for the study of the relations of population, technology, social organization, and environmental hazards, as it represents new megapolitan changes, and, at the same time follows the trends of the past.

Footnotes

Chapter II

[1] See, for example: *Proceedings: National Conference on Air Pollution*, Washington, D.C., November 18-20, 1958, U.S. Department of Health, Education, and Welfare, Public Health Service, Public Health Service Publication No. 654, (Washington, D.C. U.S. Government Printing Office, 1959; *National Conference on Air Pollution: Proceedings*, U.S. Department of Health Education, and Welfare, Division of Air Pollution, Public Health Service Publication No. 1022, (Washington, D.C.: U.S. Government Printing Office, 1963); and Committee on Pollution--*Waste Management and Control: A Report to the Federal Council for Science and Technology*, (Washington, D.C., National Academy of Sciences, National Research Council, 1966).

[2] *Ibid.*

[3] Los Angeles City Planning Department, *Preliminary General Plan*, Santa Monica Mountain Study, Los Angeles, 1962.

[4] Los Angeles County Medical Association, *Physicians Environmental Health Survey. A Poll of Medical Opinions*, Los Angeles, 1961; Edwin G. Boring, Herbert S. Langfield, and Harry Porter Weld, editors, *Foundations of Psychology* (New York: John Wiley and Sons, 1948), pp. 477-78; Karl D. Kryter, "Psychological Reactions to Aircraft Noise," *Science*, Vol. 151, No. 3716 (18 March, 1966), pp. 1346-54; Air Conservation Commission, *Air Conservation*, Washington, D.C., American Association for the Advancement of Science, 1965, publication No. 80.

[5] *Loc. cit.*, *National Conference on Air Pollution: Proceedings*, pp. 120-63; Abel Wolman, "The Metabolism of Cities," *Scientific American*, Vol. 213, No. 3 (September, 1965), pp. 178-93; Karl D. Kryter, *op. cit.*; and, "International Conference for London," *Smokeless Air, Journal of the National Society for Clean Air*, Vol. XXXVI, No. 135 (Autumn 1965), pp. 13-15.

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[6] An exception is provided by Otis Dudley Duncan, "From Social System to Ecosystem," Sociological Inquiry, Spring, 1961, pp. 140-49.

[7] See, for example: Charles N. Glaab, editor, The American City: A Documentary History (Homewood, Illinois: The Dorsey Press, Inc., 1963).

[8] Massachusetts Sanitary Commission, "Report of a General Plan for the Promotion of Public and Personal Health," Boston, Dutton and Wentworth, 1850; John H. Griscom, The Sanitary Condition of the Laboring Population of New York, New York: 1845, pp. 2-15, 23-24, 49, reprinted in Glaab, op. cit., pp. 117-30.

[9] Jacob A. Riis, How the Other Half Lives, 1890, and B. O. Flower, Civilization's Inferno, or Studies in the Social Cellar, Boston, 1893, cited in Glaab, loc. cit.

[10] See: National Commission on Law Observance and Enforcement, Report on the Causes of Crime, Vol. I and Vol. II (Washington, D.C.: U.S. Government Printing Office, 1931); Ernest R. Mowrer, Disorganization: Personal and Social (Philadelphia: J. B. Lippincott Company, 1942); Robert E. L. Faris and H. Warren Dunham, Mental Disorders in Urban Areas (Chicago: The University of Chicago Press, 1939); Ernest R. Mowrer, Family Disorganization (Chicago: The University of Chicago Press, 1927); Walter C. Reckless, Vice in Chicago (Chicago: The University of Chicago Press, 1933); Ruth Shonle Cavan, Suicide (Chicago: The University of Chicago Press, 1939).

[11] See, for example, Calvin F. Schmid, Social Saga of Two Cities (Minneapolis: The Minneapolis Council of Social Agencies, 1937); and Social Trends in Seattle (Seattle: University of Washington Press, 1944).

[12] See the summaries of the program development concerns of the National Institute of Mental Health portrayed in Leonard J. Duhl, editor, with the assistance of John Powell, The Urban Condition: People and Policy in the Metropolis (New York: Basic Books, Inc., Publishers, 1963).

[13] Jean Gottman, *Megalopolis: The Urbanized Northeastern Seaboard of the United States* (New York: The Twentieth Century Fund, 1961).

[14] Otis Dudley Duncan, "Social Organization and the Ecosystem," Robert E. L. Faris, editor, *Handbook of Modern Sociology* (Chicago: Rand McNally and Company, 1964), p. 39.

[15] *Ibid.*, pp. 36-82.

[16] Abel Wolman, "The Metabolism of Cities," *Scientific American*, *loc. cit.*

[17] A summary of the basic concepts of human ecology may be obtained from the following works: Ernest W. Burgess, "The Growth of the City, An Introduction to a Research Project," *Publications of the American Sociological Society*, Vol. XVIII, 1924, pp. 85-97; Roderick D. McKenzie, "The Ecological Approach to the Study of the Human Community," *The City*, Robert E. Park, Ernest W. Burgess, and Roderick D. McKenzie, editors (Chicago: The University of Chicago Press, 1925), pp. 63-79; Roderick D. McKenzie, "The Scope of Human Ecology," *Publications of the American Sociological Society*, Vol. XX, 1926, pp. 141-54; Robert E. Park, "The Urban Community as a Spatial Pattern and a Moral Order," *The Urban Community*, Ernest W. Burgess, editor (Chicago: The University of Chicago Press, 1926), pp. 3-18.

[18] Jack P. Gibbs and Walter T. Martin, "Urbanization and Natural Resources: A Study in Organizational Ecology," *American Sociological Review*, Vol. XXIII, No. 3 (June, 1958), pp. 266-77.

[19] Otis Dudley Duncan, "Human Ecology and Population Studies," Philip M. Hauser and Otis Dudley Duncan, editors, *The Study of Population* (Chicago: University of Chicago Press, 1959), pp. 678-716.

[20] Tomotsu Shibutani, *Society and Personality* (Englewood Cliffs, New Jersey: Prentice-Hall, Inc.), pp. 108-9.

[21] See, for example, Cynthia Lindsay, *The Natives are Restless* (Philadelphia: Lippencott, 1960); "The New America, Living Atop a Civic Mushroom," *Newsweek* (April 1, 1957), pp. 35-42; and Arthur Grey, Jr., "Los Angeles, Urban

Prototype," *Land Economics*, Vol. XXXV, No. 3 (August, 1959), pp. 232-42.

[22] John T. Middletown, "Air Conservation and the Protection of our Natural Resources," *National Conference on Air Pollution Proceedings*, U.S. Department of Health, Education and Welfare, Public Health Service, Division of Air Pollution, (Washington, D.C., 20025, 1963), pp. 166-72

[23] Arthur Grey, Jr., *op. cit.*

[24] See, for example, Eshref Shevky and Wendell Bell, *Social Area Analysis, Theory, Illustrative Application and Computational Procedures* (Stanford: Stanford University Press, 1955); and Maurice D. Van Arsdol, Jr., Santo F. Camilleri, and Calvin F. Schmid, "The Generality of Urban Social Area Indexes," *American Sociological Review*, Vol. XXIII, No. 5, June, 1958.

[25] *Ibid.*

[26] While the total growth rates of Los Angeles are greater than in many other large metropolitan communities, the processes of residential population redistribution and residential mobility appear to be quite similar to the rest of urban America. Beverly Duncan, Georges Sebagh, and Maurice D. Van Arsdol, Jr., "Patterns of City Growth," *American Journal of Sociology*, Vol. LXVII, No. 4, January, 1962, pp. 418-29, indicate that rapid metropolitan growth and a densely populated central city are conducive to rapid expansion of population while a large metropolitan area inhibits expansion in both Los Angeles and other large metropolitan areas.

[27] With respect to residential mobility, Los Angeles has typically displayed higher total mobility rates than other major metropolitan areas. *Current Population Reports, Population Characteristics*, Series P-20, No.'s 4, 14, 22, 28, 36, 39, 47, 49, 57, 61, 67, 73, 82, 85, 104, 113, 115, U.S. Government Printing Office, Washington 25, D.C. Data from the 1960 Census of Population and Housing indicate, however, that the Los Angeles residential mobility experience is similar in many respects to that found elsewhere. On the basis of the 1960 Censuses, a retrospective mobility rate may be defined as the percent of the population five

years of age and older whose place of residence in 1955 was the same Standard Metropolitan Statistical Area as in 1960. Similarily an in-migration rate is given by the percent of the population five years of age and older in 1960 with a place of residence outside of the metropolitan area of residence. In 1960 the local five year mobility rate of the Los Angeles metropolitan area was 39.8 percent as compared with 36.2 percent for all other United States metropolitan areas with a population in excess of one million. Five year in-migration rates were, respectively, 17.5 percent for Los Angeles and 9.6 percent for all other metropolitan areas. The higher level of in-migration rates for Los Angeles is not unique for this metropolis but typifies the other large Pacific Coast metropolitan areas which have a comparable rate of 21.1 percent. Furthermore, the area of the Los Angeles metropolis is such that it follows, of course, that the metropolitan area has a noticeably higher level of total mobility (57.3 percent) than other large metropolitan areas in the United States (45.8 percent). Internal mobility within Los Angeles often takes on the characteristics of long distance migration elsewhere. The similarity of the level of local residential mobility between Los Angeles and other large metropolitan areas may seem surprising to those who have maintained the myth of Los Angeles.

CHAPTER III

THE CHARACTER OF ENVIRONMENTAL HAZARDS IN LOS ANGELES

Introduction

The similarities between United States metropolises have been frequently documented in terms of observed regularities of urban social organization.[1] Metropolitan communities share the same kinds of apartment house sections, rooming house areas, slums, suburbs, central business districts, and outlying shopping centers.[2] Differences between neighborhoods within metropolises are partially a function of metropolitan size; and neighborhood distinctions are found regardless of metropolitan social histories and economic functions. Metropolitan complexes differ, however, in that each has a population that occupies an unique habitat. While metropolises are constructed on unique sites, they may share certain site features, including those leading to fire, slide, flood and air traffic noise, and a topography that facilitates air pollution. Metropolitan

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communities are thus alike in both social organization and some characteristics of the natural environment.

Utilization of the urban habitat results in mediating changes between man and nature. New environmental features include water supply and sewage systems; and street, freeway, railway, and aircraft landing patterns; as well as land utilized for commercial, industrial, recreational, residential, and transportation functions.[3] These modifications are incorporated in the metropolitan setting and result in further changes in the urban habitat.[4]

The above characteristics of metropolitan communities have long been recognized. There have been relatively few efforts, however, to systematically describe metropolitan or megalopolitan areas in terms of relations among natural environmental features, man-made alterations of urban sites, and urban social organization.[5] Particularly lacking are considerations of natural, societal, and technical constraints on behavior that are related to changes in human environments brought about by urbanization, as well as information concerning population reactions to these changes.[6]

This chapter examines certain limitations of the urban environment that result from human alterations of urban sites in Los Angeles. The limitations have been portrayed as health and economic hazards by urban planners, citizen's groups, and public health officials.[7] Hazards considered are air pollution, air traffic noise, brush fires, floods, and earth slides. In addition to their economic effects, air pollution and air traffic noise have been described as inimical to individual health,[8] while brush fires, floods, and earth slides are reflected in economic losses. The presence of these hazards in Los Angeles and Orange Counties provides an opportunity for the study of their interrelations with urban social organization and behavior. Air pollution, the major concern of our research, is contrasted with these other hazards in order to further delimit the social nature of impure air.

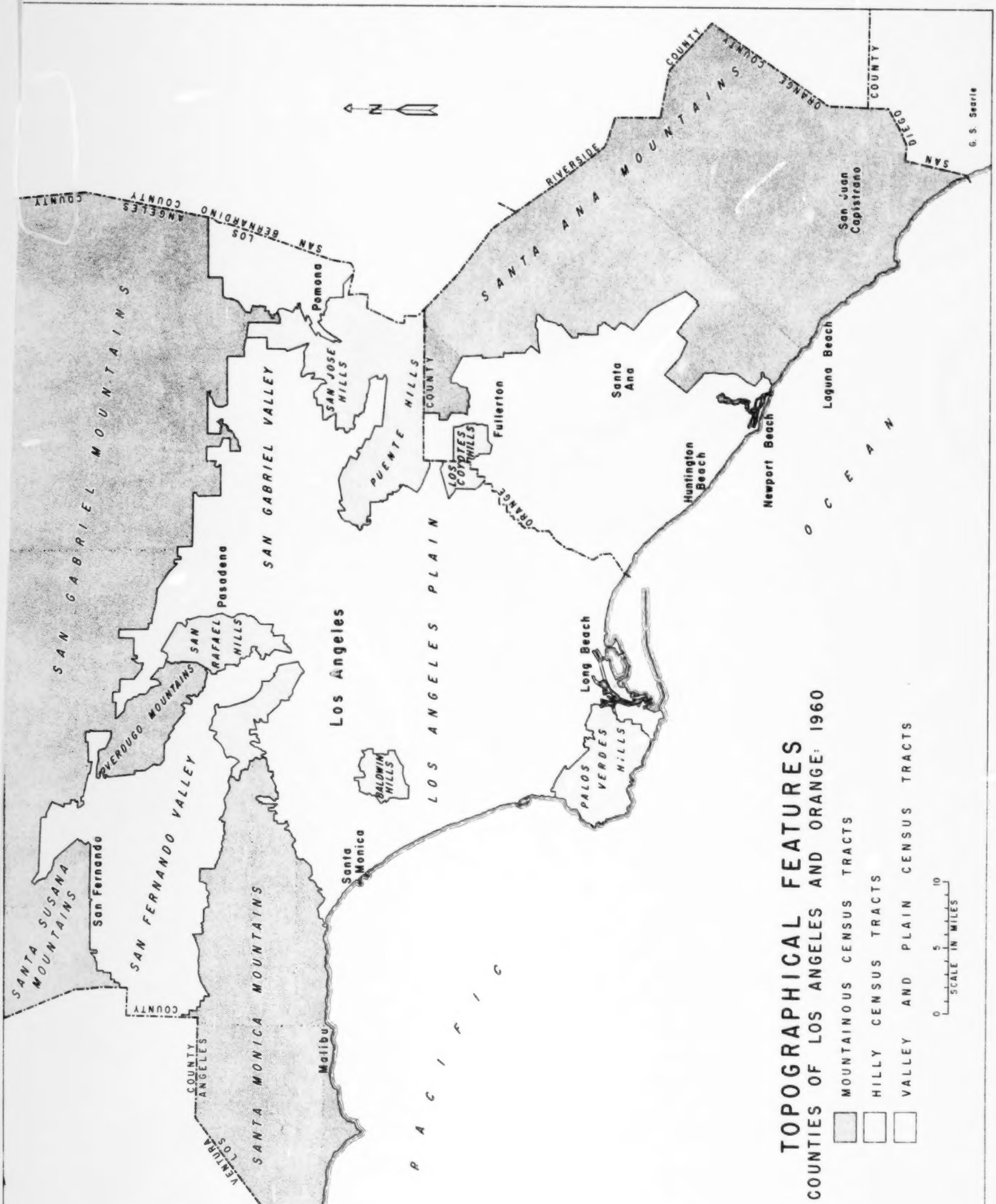
The point of departure of this chapter summarizes the "reality" of the five environmental hazards as they pertain to the spatial organization of the Los Angeles metropolitan area. Here the focus is on the manner in which "natural" and man-made conditions of the urban setting have apparently channeled environmental hazards into different subregions of the metropolis. Associations of air pollution, airplane noise, brush fires, flood, and earth slides in the emerging megalopolis are then summarized. The chapter concludes with a discussion of the possible relationship of natural and artificial hazards to the development of residential settlement patterns within metropolitan areas.

The Los Angeles Metropolitan Site

The urban natural environment.--The Los Angeles-Long Beach Standard Metropolitan Statistical Area included both Los Angeles and Orange Counties in 1960.[9] It consisted of 4,842 square miles of land areas; including snowcapped mountains, inland valleys under intense agricultural cultivation, parched desert regions, and more than 100 miles of wind-washed coastline. North-south and east-west distances are approximately 100 miles.

The physical environment of the metropolis can be visualized with reference to Figure 1. The Santa Susanna Mountains form a northern boundary for the San Fernando Valley, along with the San Gabriel Mountains, and separate the settled southern portion of the metropolis from the sparsely settled northern mountain and desert regions. (These regions are not shown in Figure 1.) The Santa Monica Mountains, which form a triangle with the base in the western portion of the area north of Malibu and with an apex

Figure 1



TOPOGRAPHICAL FEATURES
COUNTIES OF LOS ANGELES AND ORANGE: 1960

▨ MOUNTAINOUS CENSUS TRACTS
☐ HILLY CENSUS TRACTS
☐ VALLEY AND PLAIN CENSUS TRACTS

N
0
5
10
SCALE IN MILES
G. S. Searle
SAN GABRIEL MOUNTAINS
SANTA SUSANA MOUNTAINS
San Fernando
SAN FERNANDO VALLEY
VERDUGO MOUNTAINS
SAN RAFAEL HILLS
Pasadena
SAN GABRIEL VALLEY
SAN JOSE HILLS
Pomona
PUENTE HILLS
LOS COYOTES HILLS
Fullerton
Los Angeles
BALDWIN HILLS
LOS ANGELES PLAIN
SANTA MONICA MOUNTAINS
Santa Monica
Malibu
PALOS VERDES HILLS
Long Beach
Huntington Beach
Newport Beach
Santa Ana
Laguna Beach
San Juan Capistrano
SANTA ANA MOUNTAINS
PACIFIC OCEAN
VENTURA COUNTY
LOS ANGELES COUNTY
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
ORANGE COUNTY
SAN DIEGO COUNTY

pointed at Pasadena, constitute the southern boundary of the San Fernando Valley and the northwestern boundary of the Los Angeles Plain. The Santa Ana Mountains, comprise more than one-half of the area of Orange County. Other protrusions in the metropolis are the Palos Verdes Hills on the peninsula between Long Beach and Santa Monica, the Verdugo Mountains, the San Rafael Hills between Pasadena and the San Fernando Valley, the San Jose, Los Coyotes, and Puente Hills in eastern Los Angeles County, and the Baldwin Hills to the southwest of the central district of Los Angeles.

Site features of the region make for microclimatic differences between the warmer interior valleys and the cooler coastal regions and mountain and hillside areas, lead to a north-south drainage system, and channel the development of areas of rural and urban economic activity. The extensive freeway system which is largely concentrated in the valley and plain areas, intersects in downtown Los Angeles. Human alterations of the metropolitan habitat have intensified effects of temperature inversions associated with air pollution, raised noise levels in areas adjacent to airports, and have led to brush fires, earth slides, and floods in regions undergoing initial conversion to urban land use.

Sources of environmental hazard data.--Delineation of environmental hazards within metropolitan areas has been the focus of much research in the past few decades. The "reality" of hazards as determined by physical measurements is dependent upon population perceptions and action. In Los Angeles and Orange Counties, for example, air pollution control district staffs may sometimes locate smog monitoring stations on the basis of complaints of populations that perceive smog as being present in their areas of residence. Monitoring stations are sometimes not located in affected but unoccupied areas where there are no populations present to perceive smog. Environmental hazards in remote or uninhabited regions may not be recorded unless they are brought to the attention of appropriate monitoring organizations.

In the Los Angeles metropolitan area, air pollution control districts, airport authorities, insurance companies and engineering offices have established a data base descriptive of the internal environment. Data from these organizations were utilized to delimit urban sub-areas characterized by air pollution, air traffic noise, brush fires, flood, and slides. There are many forms of air pollution, including sulfer dioxide, cement plant dust, industrial smoke, industrial gases, dust from agricultural operations, insecticide contamination, coal smoke, and gases from sewage operations.[10] Different forms of air pollution have different types of social and economic consequences. This research is concerned with photochemical air pollution generated by the fire utilizing activities of the metropolis--particularly the internal combustion engine, and industrial operations.[11]

Oxidant level data were obtained which reflect the "smog" or photochemical nature of Los Angeles air pollution, which is largely associated with the automobile. Smog is produced when nitrogen oxides (NO) and other combustion formed hydrocarbons are emitted into the atmosphere and exposed to sunlight, thus generating nitrogen dioxide. Environmental effects of photochemical air pollution include decreased visibility, vegetation damage, and materials damage; while in human populations, smog may be associated with eye, nose, and throat irritation, acute respiratory illness, and chronic lung disease.[12]

Technological and environmental features necessary to account for the presence of Los Angeles smog consist of pollutants expelled into the atmosphere from such sources as automobile exhausts, and industry; and the limited degree of air ventilation and circulation in the Los Angeles airshed, which lies between the hills and mountain areas. The latter is contributed to by a "temperature inversion," which prevents pollutants from rising into the upper atmosphere, and which is present for approximately 270 days a year. In this study, a four category "smog scale" based on isolines extrapolated from air pollution recording stations was established. Cutting points on the scale are indicative of levels at which there are changes in reported physiological symptoms associated with oxidant exposure.[13] For most of the subsequent analyses, no distinctions are made as to differences in oxidant levels, and subareas are classified according to the presence or absence of smog.

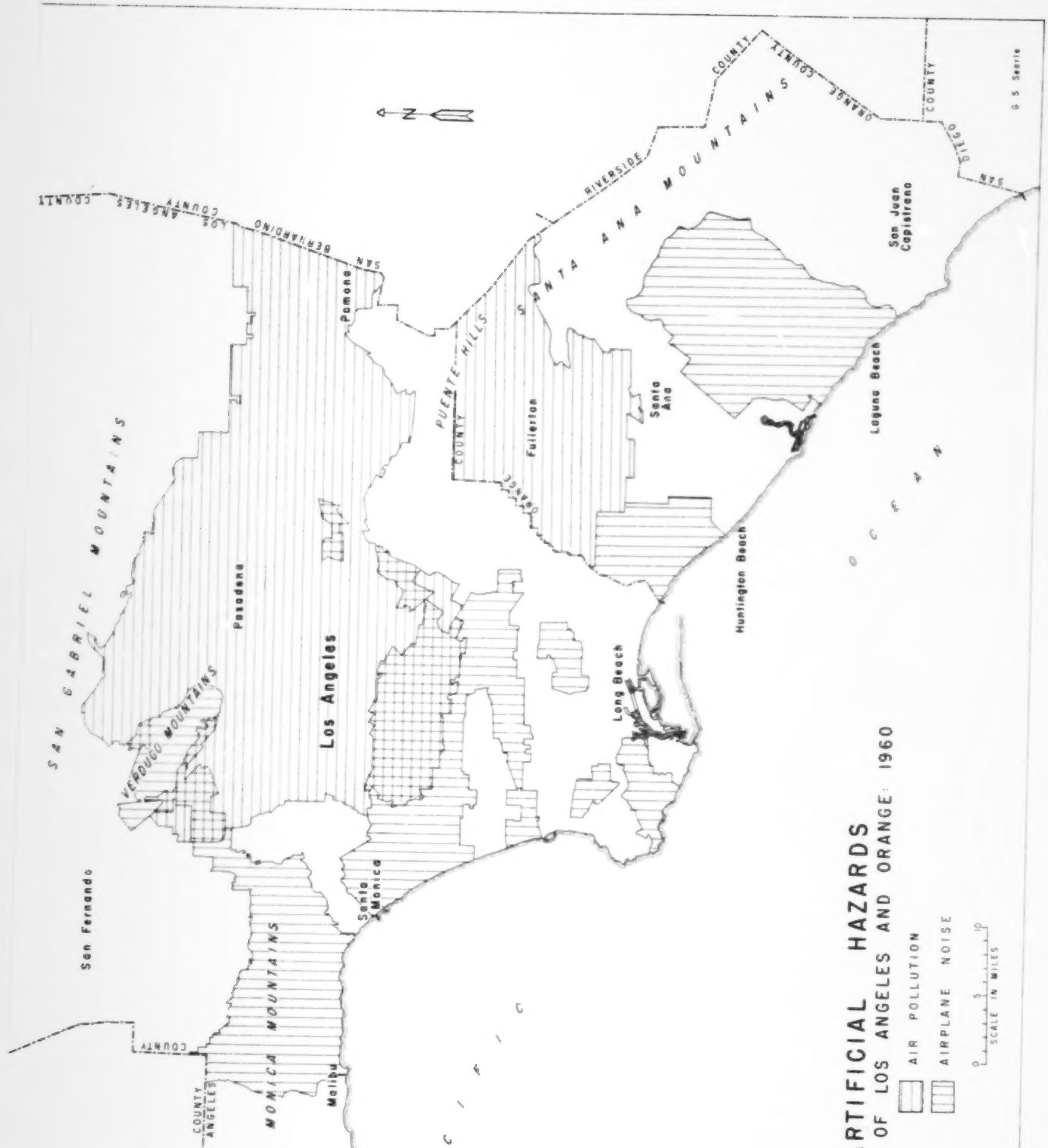
Data on air traffic noise were obtained from airport authorities in the Los Angeles area. Particular attention was given to those accommodating jet and other large commercial aircraft. Differing air traffic noise areas were defined on a three-point scale[14] by noise decibels, for areas under usual flight patterns. These noise areas were partially delimited on the basis of judgments of airport authorities. Subareas were normally classified by the presence or absence of air traffic noise for the data analysos pertaining to this hazard.

Four levels of brush fire hazard were determined as based on brush fire insurance surcharge rates established by the Pacific Fire Rating Bureau.[15] Brush fires were recorded by their presence or absence for most subsequent analyses. Flood areas were designated by the Los Angeles and Orange County Flood Control Districts as sections in which water had "ponded" or was in sufficient depth to damage property by silt deposition during a recent major rain storm.[16] Earth slide areas were specified as those for which the Los Angeles and Orange County Engineer's Offices have reported earth slippage during recent years.[17]

It is emphasized that the hazard data obtained do not reflect controlled laboratory measurements. Furthermore, all data for the five hazards were allocated to census tract grids by isoline techniques. If tract boundaries were not contiguous with pre-established hazard boundaries, hazard scores for the tracts were based on the scores for their larger portions. Census tracts classified as containing one level of hazard, may, on closer examination, contain subsections where the hazard is more or less apparent than is attributed to the tract as a whole. Moreover, the hazards are crudely delimited for urban subareas, due to the judgmental and organizational factors involved in the specification of hazard levels.

Spatial patterns of environmental hazards.--Figure 2 summarizes the Los Angeles metropolitan area distribution of the artificial hazards of air pollution and air traffic noise. Hazards are recorded according to their presence or absence, and differences in the degree of hazards are not specified. Photochemical pollution, of the Los Angeles variety, has been recorded in such disparate places as Boston, Buffalo, Charlestown, Chicago, Kansas City, Nashville, Phoenix, St. Louis, Salt Lake City, and Washington, D.C.[18] Motor vehicles, however, are a more important source for pollutants in Los Angeles than in some other metropolises, and the local combination of topographical features and temperature inversion is not necessarily duplicated elsewhere. A comparison of Figure 2 with Figure 1 indicates that the most extensive concentrations of smog are in the valley and plain areas, which contain the major intersections of the freeway system. The prevailing westerly winds tend to push air pollution to the eastern sections of Los Angeles County and against the base of the San Gabriel Mountain. Heavy smog is found in the downtown section of the City of Los Angeles, and extends northward to Pasadena

Figure 2



ARTIFICIAL HAZARDS
COUNTIES OF LOS ANGELES AND ORANGE: 1960

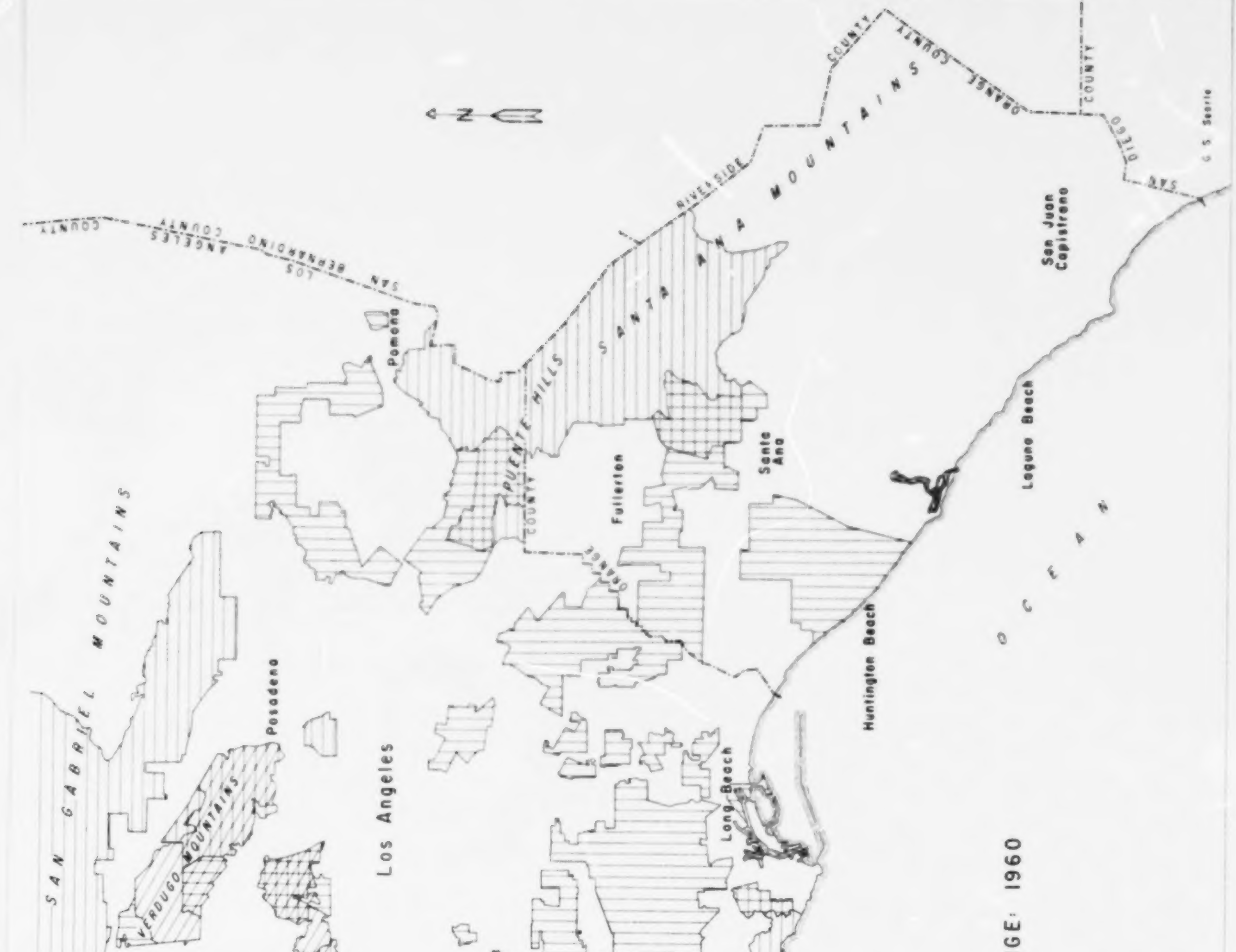
▤ AIR POLLUTION
▥ AIRPLANE NOISE
0 5 10
SCALE IN MILES
N
SAN GABRIEL MOUNTAINS
VERDUGO MOUNTAINS
SANTA MONICA MOUNTAINS
SANTA ANA MOUNTAINS
PUENTE HILLS
San Fernando
Pasadena
Los Angeles
Pomona
Fullerton
Santa Ana
Santa Monica
Malibu
Long Beach
Huntington Beach
Laguna Beach
San Juan Capistrano
PACIFIC OCEAN
LOS ANGELES COUNTY
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
ORANGE COUNTY
SAN DIEGO COUNTY
VENTURA COUNTY
G S Searle

and eastward along the base of the San Gabriel Mountains to the boundary of the metropolitan area. Moderate smog levels are located in the triangle formed by downtown Los Angeles, Pasadena, and Pomona; the Verdugo Mountains; and the area north of Santa Ana. The western and coastal portions of Los Angeles and Orange Counties, ranging from San Fernando to Malibu and then southeast to San Juan Capistrano, have negligible smog.

The geographic distribution of air traffic noise, shown in Figure 2, delimits the major airport landing patterns. One region of perceived and severe noise surrounds the Los Angeles International Airport, which lies midway between Long Beach and Santa Monica. Another noise region is associated with the Burbank Airport and extends from the Santa Monica Mountains in Malibu to San Fernando. The El Toro Marine Corps base landing pattern to the southeast of Santa Ana has severe noise, and noise is here perceived in a section extending to the Pacific Ocean. Other air traffic noise areas are found in proximity to scattered landing strips and airports throughout the metropolis.

Figure 3 summarizes the recorded presence or absence of the natural hazards of brush fires, earth slides, and floods for the Los Angeles metropolis. Brush fire areas

Figure 3



NATURAL HAZARDS

COUNTIES OF LOS ANGELES AND ORANGE: 1960

BRUSH FIRE
FLOOD
EARTH SLIDE
0 5 10
SCALE IN MILES
N
SAN GABRIEL MOUNTAINS
VERDUGO MOUNTAINS
SANTA MONICA MOUNTAINS
PUENTE HILLS
SANTA ANA MOUNTAINS
San Fernando
Pasadena
Los Angeles
Santa Monica
Malibu
Long Beach
Huntington Beach
Pomona
Fullerton
Santa Ana
Laguna Beach
San Juan Capistrano
PACIFIC OCEAN
VENTURA COUNTY
LOS ANGELES COUNTY
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
ORANGE COUNTY
SAN DIEGO COUNTY

are limited to the County of Los Angeles, and are found in the Santa Monica and Verdugo Mountains. These areas have a high density of greasewood and other potentially combustible vegetation, and are in some locations, relatively inaccessible to fire-fighting equipment. Severe risk areas are in the eastern portion of the mountains, in the areas north of Malibu, and in a portion of the Verdugo Mountains. Areas of moderate and slight risk are located in the Verdugo Mountains, and in sections of the Santa Monica Mountains north of Santa Monica and closer to the center of Los Angeles. The latter section, however, was subjected to a disastrous fire in 1961. Although the brush fire hazard areas have a recent fire history, they do not encompass all areas subject to fire, since uninhabited areas characterized by brush fires in the San Gabriel Mountains were not included in the surcharge rates of the Pacific Fire Rating Bureau. Figure 3 also shows that earth slides follow the pattern of concentration of brush fires in steeply sloped sections of the Santa Monica and Verdugo Mountains. Other earth slide sections include the Portuguese Bend portion of the Palos Verdes Peninsula between Long Beach and Santa Monica, and sections in Los Angeles and Orange Counties south of Pomona. As is indicated in Figure 3, areas with flood danger are scattered throughout the metropolitan area and include sections of the Santa Monica Mountains, Palos Verdes Peninsula, coastal regions and areas near Pomona that lack complete systems of storm drains. Recent additions of storm drainage facilities are now rapidly changing the flood pattern in the metropolis.

Hazard Exposure in the Metropolis

The incidence of hazard exposure.---Tables 1 and 2 indicate the area and population of Los Angeles and Orange Counties combined that were exposed to smog, air traffic noise, brush fires, flood and slide as of approximately 1960. Hazards are here categorized by their presence or absence. As is indicated by Tables 1 and 2, more than one-seventh of the land area of the metropolis and more than one-half of the residential population was delimited as exposed to smog in 1960. Approximately one-seventh of the land area and one-fifth of the residential population was exposed to airplane noise. These figures underestimate total population exposure to these hazards, due to concentrations of places of employment in areas with artificial hazards, and the exposure of the commuting population to the smog generated by their vehicles. Approximately one-fifth of the land area was exposed to earth slides; and one-fifth

TABLE 1

AREA EXPOSURE TO HAZARDS, AND CONVERGENCE OF HAZARDS BY AREA,
LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA: 1960

Hazard	Acres Exposed[a]	Percentage of Area Exposed	Percentage of Exposed Area Also Exposed to Additional Hazard				
			Smog	Noise	Fire	Flood	Slide
Smog	573.4	14.8		5.7	3.2	9.3	13.2
Noise	716.4	15.8	5.4		10.6	7.9	5.7
Fire	21.7	4.3	11.2	39.0		14.7	62.4
Flood	62.8	6.1	22.6	10.4	5.1		21.6
Slide	89.1	21.6	9.1	4.2	12.1	6.2	

[a] Acres in 1,000's.

TABLE 2

RESIDENTIAL POPULATION EXPOSURE TO HAZARDS, AND CONVERGENCE OF EXPOSURE BY AREA, LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA: 1960

Hazard	Population Exposed[a]	Percentage of Population Exposed	Percentage of Exposed Population Also Exposed to Additional Hazard				
			Smog	Noise	Fire	Flood	Slide
Smog	3,407.6	50.6		14.8	1.6	7.5	1.9
Noise	503.9	21.0	35.7		3.7	19.4	3.2
Fire	56.0	2.6	32.3	30.5		25.4	75.4
Flood	65.4	18.1	21.2	22.9	3.7		7.4
Slide	254.5	4.6	21.3	14.9	42.5	29.0	

[a] Population in 1,000's.

of the residential population, which is concentrated in lowland areas, was exposed to flood. Brush fires, on the other hand, affect only a small percentage of the area or residential population of the metropolis.

Tables 1 and 2 also indicate the convergence of hazards in the metropolitan area by exposure of area and residential population. A reading across each row of the left hand side of Tables 1 and 2 indicates the percentages of the area or population exposed to a particular hazard that is also exposed to additional hazard. Thus, in Table 1, the cell at the intersection of the smog row and the noise column shows that 5.7 per cent of the 673,400 acres exposed to smog are also exposed to noise, while the cell at the intersection of the noise row and the smog column indicates that 5.4 per cent of the 716,400 acres exposed to noise are also exposed to smog. A similar interpretation is made of the data in Table 2, which indicates that 14.8 per cent of the 3,407,600 persons residentially exposed to smog were also exposed to aircraft noise, while 35.7 per cent of the 503,900 persons living in noise areas were also exposed to smog. It is clear from these data that different hazards tend to affect different areas of the metropolis and different residential populations. Only in the instance of brush fires, was it found that more than one half of the population and area affected by a hazard also affected by a second hazard. Figures 1 through 3, and Tables 1 and 2 indicate that there are few inhabited areas within the metropolis that are not characterized by at least one of the considered environmental hazards.

The association of environmental hazards.---Tables 1 and 2 have and Figures 2 and 3 have shown some overlap between areas and residential populations exposed to the fire environmental hazards. The *degree* of hazard association by combined census tract areas and populations is indicated by Table 3. This table summarizes residential population and area exposure, population per gross acre, and the ratio of phi/phi maximum correlations of residential population and urban subarea exposures to the hazards for the metropolitan area, and its Los Angeles and Orange County components. The phi/phi maximum associations for areas exposed to hazards are generally small for the total metropolis. With reference to population exposure, the degree of differentiation by hazard area is somewhat greater for the metropolis as a whole. Smog exposure of residential population is here negatively related to living in areas which are characterized by other hazards.

TABLE 3

RESIDENTIAL POPULATION AND AREA EXPOSURE, POPULATION PER GROSS ACRE, AND PHI/PHI MAXIMUM INTERCORRELATIONS OF RESIDENTIAL POPULATION AND URBAN SUBAREA EXPOSURE TO ENVIRONMENTAL HAZARDS, LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA: 1960[1]

Area Exposure	Population Exposure					Per Cent Area Exposed	Total Population Per Gross Acre	
	Smog	Airplane Noise	Fire	Flood	Slide		Hazard	Non-Hazard Area
Standard Metropolitan Statistical Area								
Smog		-.30	-.40	-.62	-.46	14.8	5.1	0.9
Noise	-.11		.01	.02	-.01	15.8	2.0	1.4
Fire	-.04	.07		.09	.74	4.3	0.9	1.5
Flood	.09	.02	.09		.14	6.1	4.4	1.3
Slide	-.07	-.20	.51	.00		21.6	8.3	1.8
Per Cent Population Exposed	50.6	21.0	2.6	18.1	4.6		Total Population Per Gross Acre 1.5	
County of Los Angeles								
Smog		-.24	-.39	-.77	-.54	22.1	5.2	1.5
Noise	-.04		.01	.03	-.01	7.7	6.9	2.0
Fire	-.13	.33		.10	.74	7.4	.9	2.4
Flood	-.11	.15	.06		.12	7.8	5.1	2.1
Slide	-.09	.08	.56	.07		13.8	.8	2.6
Per Cent Population Exposed	50.0	22.2	2.9	16.9	4.6		Total Population Per Gross Acre 2.4	

TABLE 3--Continued

Area Exposure	Population Exposure					Per Cent Area Exposed	Total Population Per Gross Acre	
	Smog	Airplane Noise	Fire	Flood	Slide		Hazard	Non-Hazard Area
				County of Orange				
Smog	. .	-.24	. .	.15	.42	5.3	3.6	0.2
Noise	-.06	. .	. .	-.06	-.04	26.2	.2	0.4
Fire	. .	. .	. .	. .	. .	. .	. .	. .
Flood	.43	-.01	. .	. .	.45	3.5	3.0	0.3
Slide	.00	-.45	. .	-.02	. .	30.9	.1	0.5
Per Cent Population Exposed	55.4	11.1	0.0	29.0	4.0		Total Population Per Gross Acre .4	

[1] Analysis includes the 1401 tracts of Los Angeles and Orange Counties, including river courses, streams, reservoirs, and lakes. Population and dwelling unit totals on which this table is based are summed from tract data and do not balance exactly with published totals.

Environmental preconditions for specific types of urban land use, coupled with differences in social utilization of different urban sites, apparently have made for a high degree of differentiation of areas and populations exposed to different hazards in Los Angeles and Orange Counties. Exceptions include the high association of fire and slide exposed areas and populations in the total metropolis and in Los Angeles County, and the flood and smog, and flood and slide associations in Orange County. These exceptions generally reflect disturbances related to the same phenomena. Burned over areas, which have frequently lost their vegetation cover, are subject to slides after rain storms, and floods and slides are also a concomitant of heavy rains in Southern California. Nevertheless, a lack of uniformity in the geophysical environment and urban settlement patterns, means that specific environmental disturbances occur in different portions of the metropolitan ecological system.

Density of settlement and environmental hazards.--Given the differentiation of hazard areas and hazard affected residential populations, there may still be similarities in man-environment relations for populations exposed to or not exposed to different types of hazards. Residential population densities provide a crude measure of the intensity of one form of use of the urban habitat. Table 3 summarizes density differentials between hazard and non-hazard areas. In both Los Angeles and Orange Counties, as well as in the total metropolis, residential population densities per gross acre are much higher in smog than in non-smog areas. For the metropolitan area and Los Angeles County, though not for Orange County, densities are higher in areas exposed to air traffic noise than those areas not exposed to noise. In Orange County, the relatively low total settlement density may still facilitate location of aircraft landing patterns in uninhabited areas. This picture may now be changing with the settlement of the Irvine Ranch area south of Santa Ana.

Flood areas show higher densities than non-flood areas in both Los Angeles and Orange Counties as well as in the total metropolitan area. Brush fire areas, which are present only in Los Angeles County, have lower population densities than non-fire areas, while earth slide areas show lower densities in both county components of the metropolis. Furthermore, data for Los Angeles County, which has areas with all combinations of two hazards confirm this pattern.

Information not shown indicates tha . in Los Angeles

County, with the exception of flood, population densities for each natural hazard combination are less in areas subject to two natural hazards than in areas with no or one natural hazard, and artificial hazard areas have higher population densities than areas with or without natural hazards. The same pattern was found for the total metropolitan area. These differences are combined with a convergence of fire and slide in outlying and mountainous areas, and a focus of airplane noise and air pollution in the more urban segments of the metropolis. Given a constricted area for urban settlement, as is now found in Los Angeles County, residential population density is directly related to the artificial hazards of smog and air traffic noise. On the other hand, density is inversely related to the natural hazards of brush fires and earth slides, and directly related to floods. These differences suggest similarities as well as differences in the character of natural and artificial hazards.

The Role of Hazards in Urban Development

Environmental hazards appear to have a definitive place in the development of the urbanized segments of metropolitan and megalopolitan areas. Brush fires and earth slides may reflect a lack of rapid application of resource preserving technology to urbanizing segments of the metropolis. Floods may indicate a lack of storm drains and sewage systems in low lying densely populated segments of either recently settled or older portions of the metropolis. Such hazards are primarily economic in their effects and represent initial disturbances of the pre-urban environment. As settlement densities in different segments of the metropolis increase, changes resulting from increasing urbanization may then be seen in the intrusion of such artificial hazards as air pollution and airplane noise into more urban segments. In this sense, urbanization within the metropolis can lead to the activation of different hazards at different stages of the urbanization cycle. The differences in density data from hazard and non-hazard areas of different portions of Los Angeles and Orange Counties have led to these assertions. Chapter IV describes how urban development results in these hazards, and the manner in which environmental disturbances are related to the spatial organization of the metropolis.

Footnotes

Chapter III

[1] See, for example, studies summarized by James A. Quinn, *Human Ecology* (Englewood Cliffs, N.J., 1950); and Otis Dudley Duncan and Albert J. Reiss, Jr., *Social Characteristics of Urban and Rural Communities, 1950* (New York: John Wiley and Sons, 1956).

[2] *Ibid.*

[3] Paul B. Sears, *The Ecology of Man*, Condon Lectures, Oregon State System of Higher Education, Eugene, Oregon, 1957; and Philip Wagner, *The Human Use of the Earth* (Glencoe, Ill.: The Free Press, 1960).

[4] Wagner, *loc. cit.*

[5] An exposition of a theoretical system combining these variables is provided in Walter Firey, *Mind, Man, and Land, A Theory of Resource Use* (Glencoe, Ill.: The Free Press, 1960). Also see Otis Dudley Duncan, *et al.*, *Metropolis and Region* (Baltimore, Maryland: John Hopkins, 1960). *Metropolis and Region*, for summaries of the differences *between* metropolises with respect to human alterations of environmental sites and urban social and demographic organization.

[6] One exception is Otis Dudley Duncan's use of air pollution as an illustration of an ecological system comprising interrelations of metropolitan population, organization, technology, and environment. See "From Social Systems to Ecosystem," Sociological Inquiry (Spring, 1961), pp. 140-49.

[7] Los Angeles County Medical Association, *Physicians Environmental Health Survey: A Poll of Medical Opinion*, Los Angeles, 1961; and Los Angeles City Planning Department, *Preliminary General Plan*, Santa Monica Mountain Study, Los Angeles, 1962.

[8] Los Angeles County Medical Association, loc. cit.; Edwin Garriguis Boring, Herbert Sidney Langfeld, and Harry Porter Wald (eds.), Foundations of Psychology (New York: John Wiley and Sons, 1948), pp. 477-78; and Los Angeles City Planning Department, loc. cit.

[9] On October 18, 1963, Orange County was removed from the Los Angeles-Long Beach Standard Metropolitan Statistical Area by the Bureau of the Budget and designated as the Orange County Standard Metropolitan Statistical Area. The Los Angeles-Long Beach Standard Metropolitan Statistical Area now consists of Los Angeles County.

[10] Philip A. Leighton, "Geographical Aspects of Air Pollution," The Geographical Review, LVI, No. 2 (April, 1966), 164.

[11] Ibid.

[12] National Conference on Air Pollution Proceedings. U.S. Department of Health, Education, and Welfare, Public Health Service, Division of Air Pollution, Washington, D.C. 20025, 1963.

[13] While air pollution may be of a number of varieties, it is here measured by an oxidant index which is oriented to the photochemical nature of the Los Angeles phenomenon. The four category smog scale is based on atmospheric oxidant data indicating parts of oxidants per one hundred million parts of air collected by the Los Angeles County Air Pollution Control District (APCD). The information as to parts per hundred million of oxidant used to delimit heavy, moderate, light, and negligible smog areas is confidential. Eye irritation, however, is often reported by large numbers of persons when the level changes from negligible to light. See California Standards for Ambient Air Quality, Air Pollution and Smog, Los Angeles Air Pollution Foundation, 1960, p. 17.

[14] Particular attention was given to those airports which accommodate jet and other large commercial aircraft. For three airports--Hughes, Los Angeles International, and the El Toro Marine Corps Air Base--were exact sound data are available and it is possible to identify the areas where the noise levels reached 90 perceived noise decibels (PNDB)

or more. Air traffic noise areas were divided into the following categories: severe--areas characterized as having severe noise where the noise levels were 90 PNDB or above (other airports may have noise levels this high, but data were not available); perceived--areas which are directly under the usual flight patterns of military and commercial air traffic patterns; and none--areas which are not subject to air traffic noise.

[15] The brush fire insurance surcharge rates, which are based on the extent of brush and the availability of fire-fighting equipment, were used to construct the following scale: severe risk--$.55 to $.66 surcharge per $100.00 assessed valuation; moderate risk--$.38 to $.54 surcharge per $100.00 assessed valuation; slight risk--$.22 to $.37 surcharge per $100.00 assessed valuation; and no risk--no brush fire surcharge. The Adman Fire Insurance Dwelling Rate Atlas of Los Angeles County, Los Angeles, Renie Map Company, [n.d.], was used to assign a scale to each census tract.

[16] Flooding, defined by Los Angeles County Flood Control District officials, refers to an area where water has "ponded" or is in motion in sufficient depth to damage property due to its presence or due to the deposition of silt. The Los Angeles and Orange County Flood Control Districts provided data on areas flooded in the storm of February 7-12, 1962, based on survey crew field observations.

[17] Areas that are steeply sloped and are composed largely of shale are most frequently subject to earth slides.

[18] John T. Middleton, "Air Conservation and the Protection of Our Natural Resources, National Conference on Air Pollution Proceedings, U.S. Department of Health Education and Welfare, Public Health Service, Division of Air Pollution, (Washington D.C. 20025, 1963), pp. 166-72.

CHAPTER IV

SOCIAL ORGANIZATION AND ENVIRONMENTAL HAZARDS

Introduction

The previous chapter has suggested that environmental hazards have a definitive place in Los Angeles' metropolitan development. Population density was directly related to the presence of the artificial hazards of air pollution and air traffic noise, and the natural hazard of flood; and inversely related to the presence of the natural hazards of brush fires and earth slides. In this respect, brush fires, earth slides, and floods, are expected to reflect initial changes of land to urban uses, while air pollution and air traffic noise are assumed to result from increased urbanization. This chapter examines the genesis of hazards in Los Angeles from 1940 to 1960. Relations of hazards to urban social structure are then described. In conclusion, there is a consideration of the associations between air pollution, population redistribution, and the changing character of Los Angeles neighborhoods.

The Housing Cycle and the Genesis of Environmental Hazards

The housing cycle.--The economists Hoover and Vernon have described urban neighborhood development as proceeding typically in a cycle from subdivision and building up, through a transition to more intensive land use, downgrading, thinning out, and finally, urban renewal.[1] Population growth rates are presumed to decelerate as succession proceeds; peak rates occur during building up phases and population decreases may be found during the thinning out stages. The Hoover-Vernon stages are a variant on Burgess's hypothesis of city growth and general cycles in the "life history of neighborhoods."[2] With the exception of initial construction and urban renewal, the housing cycle represents a gradual aging of housing stock, which may be accompanied by social deterioration of the environment.[3] Neighborhoods of comparable age and original housing quality, however, can be maintained as showplaces for the elite, or "filter down," in deteriorating condition, to different urban sub-populations.[4] While the cycle reflects neighborhood histories, its stages are not necessarily predictive of the social and economic differentiation found between residential areas.

Previous studies of internal changes in American cities suggest that neighborhood differentiation results from alterations of the nature of urban subareas or substitutions of new functions or populations.[5] To these activators, we would add certain environmental limitations resulting from cumulative applications of technology. Past urban research has emphasized effects of the first factors upon social organization. Relatively little attention, however, has been given to the role of environmental change.[6]

Chapter III has suggested, that, the artificial hazards of air pollution and air traffic noise, which represent a potential danger to individual health, appear to be products of continued urbanization within certain metropolitan segments. These hazards may possibly contribute to a temporal shortening of the housing cycle and a more rapid filtering down of dwellings to new subpopulations. On the other hand, the natural Los Angeles hazards of flood, brush fire, and slide are apparently economic in their effects and occur as a result of environmental changes in the first cycle stages. It may be that economic losses in slide and brush fire areas are borne largely by those families who can afford the risk of obtaining housing in areas under conversion to urban use.

Both natural and artificial hazards may intervene in neighborhood development. The character of urban subareas is postulated as influenced by the housing cycle, plus environmental hazards, which in turn, are related to further urban development. The following discussion indicates ways in which the housing cycle can be measured; describes associations of cycle components with environmental hazards in the Los Angeles metropolitan area for 1960; and shows how changes in the cycle are associated with the development of air pollution in Los Angeles County by 1950, and the continuation of air pollution in 1960.

Measurement of the housing cycle.--Neither Burgess nor Hoover and Vernon have explicitly described the housing cycle with longitudinal data. Duncan, Sabagh, and Van Arsdol have catalogued the cycle for the City of Los Angeles with respect to "cohorts" of residence areas classified by the dates at which they were "built-up" or reached initial settlement maturation.[7] Indexes of dates of settlement, however, merely specify the ages of urbanized residential neighborhoods. They do not encompass other cycle components which are here inferred from the Hoover-Vernon description. These include the _age of the housing stock_ currently present in neighborhoods (which may contrast with the age of neighborhoods, as specified by dates of settlement), construction of multiple family housing, encroachment of nonresidential land uses, and changing population densities.[8] Comparisons of the housing cycle with environmental hazards rest on an assumption that adequate measures, which are positively associated, may first be obtained of the cycle. A test of this assumption should indicate that general outlines of neighborhood changes in Los Angeles and Orange Counties coincide with the Hoover-Vernon description.

The Hoover-Vernon stages do not portray points on a continuum of change subject to direct measurement with census tract data. It was therefore necessary to determine if indirect measures of inferred components of the cycle were interrelated in the manner implied. Indexes of date of settlement, age of housing, percentage of multiple family dwelling units, percentage of land area in industrial, commercial, and transportation functions, and population density were used to describe the housing cycle. It was assumed that increases in these measures were positively correlated with inferred components of the Hoover-Vernon stages, and that all of the measures would be positively associated.

The date of settlement index was used to classify the 1403 census tracts of Los Angeles and Orange Counties in 1960 by whether they were "built up" or "not built up" to a two dwelling unit per gross acre density criterion prior to 1940, in the 1940's, in the 1950's, or were not built up by 1960. Density of housing at previous dates, as estimated from the number of census housing units in 1960 reported by their occupants as built prior to 1940, in the 1940's, and in the 1950's, was used to construct the index.[9] Date of settlement describes the time that has elapsed since neighborhoods passed into "urban" land use, and provides a control on historical growth of urban areas that is necessary for an understanding of subsequent development.[10]

The age of housing index[11] was defined as the arithmetic average of the set of cumulated proportions of 1960 standing housing units that had been constructed from 1950 to 1960, and 1940 to 1950.[12] The resulting index values for a given census tract, which implicitly assigns equal temporal weight to the 1940 to 1950, and 1950 to 1960 periods, and the time period prior to 1940, can vary from .00, when all housing units were constructed prior to 1940, to 1.00, when all housing units were constructed during the 1950 to 1960 decade. The 1960 mean tract index value for Los Angeles and Orange Counties combined was .52, indicating that the 1960 housing stock of the mean tract was constructed in the 1940's.

Percentages of dwelling units in census tracts that were of multiple family construction were defined by 1960 census tract data. Tract acreage information obtained from the Los Angeles Region Transportation Study of the State of California Division of Highways was utilized to delimit the proportions of census tracts in transportation, commercial, and industrial use. Population density per gross census tract acre was derived from a combination of census and from Los Angeles Region Transportation Study data.

Table 4 shows the product moment census tract correlations of the five housing cycle measures for the Los Angeles metropolitan area, and for Los Angeles and Orange Counties in 1960. Date of settlement is treated as a four category quantitative variable. Values of the date of settlement and age of housing indexes are reversed, in order to vary in the same assumed direction as the other measures. Relations between the measures generally confirm the Hoover-Vernon portrayal of the cycle; an exception is the percentage of land in commercial, industrial and

TABLE 4

PRODUCT MOMENT INTERCORRELATIONS OF MEASURES OF HOUSING CYCLE STAGES, LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA: 1960

Housing Cycle Measure		Age of Housing[1]	% Multiple Family Dwelling Units	% Commercial Industrial, Transportation Land	Population Density
Date of[1, 2] settlement	SMSA[4]	.54	.54	.11	.73
	L.A. County[5]	.54	.54	.08	.71
	Orange County[6]	.44	.36	.33	.70
Age of[1] housing	SMSA		.44	.19	.40
	L.A. County		.44	.18	.40
	Orange County		.34	.35	.01
% Multiple Family dwelling units	SMSA			.34	.56
	L.A. County			.34	.56
	Orange County			.22	.08
% Commercial, Industrial, transportation land	SMSA				.03
	L.A. County				.00
	Orange County				.22

[1] Index values reversed.

[2] Ordinal measure treated as a quantitative variable.

[3] SMSA = Los Angeles Standard Metropolitan Statistical Area.

[4] $r = .06$ significant .05 level.

[5] $r = .06$ significant .05 level.

[6] $r = .20$ significant .05 level.

transportation use. For Los Angeles and Orange Counties combined, all measures showed significant positive covariation, with the exception of the relation between population density and percentage of land in commercial, industrial, and transportation use. Low correlations of the land use measure with other housing cycle indexes perhaps reflect the suburbanization and disengagement from the housing cycle of commerce, industry, and transport functions established since World War II. A somewhat closer pattern of association between all of the measures is generally found for Los Angeles than for Orange County. The relatively low intercorrelations of the measures, however, suggests that they are indicative of different aspects of the housing cycle, and may be related to hazards in contrasting fashion.

Age of housing, date of settlement, and environmental hazards in 1960.--Figure 4 shows, for the Los Angeles metropolis, proportions of census tracts of different housing ages with environmental hazards present. The presence of air pollution approximates a reversed "J" shaped curve; likelihood of smog varies from .88 for tracts in the oldest age category, to .30 for immature tracts, and increases to .38 for those in the youngest housing segment.

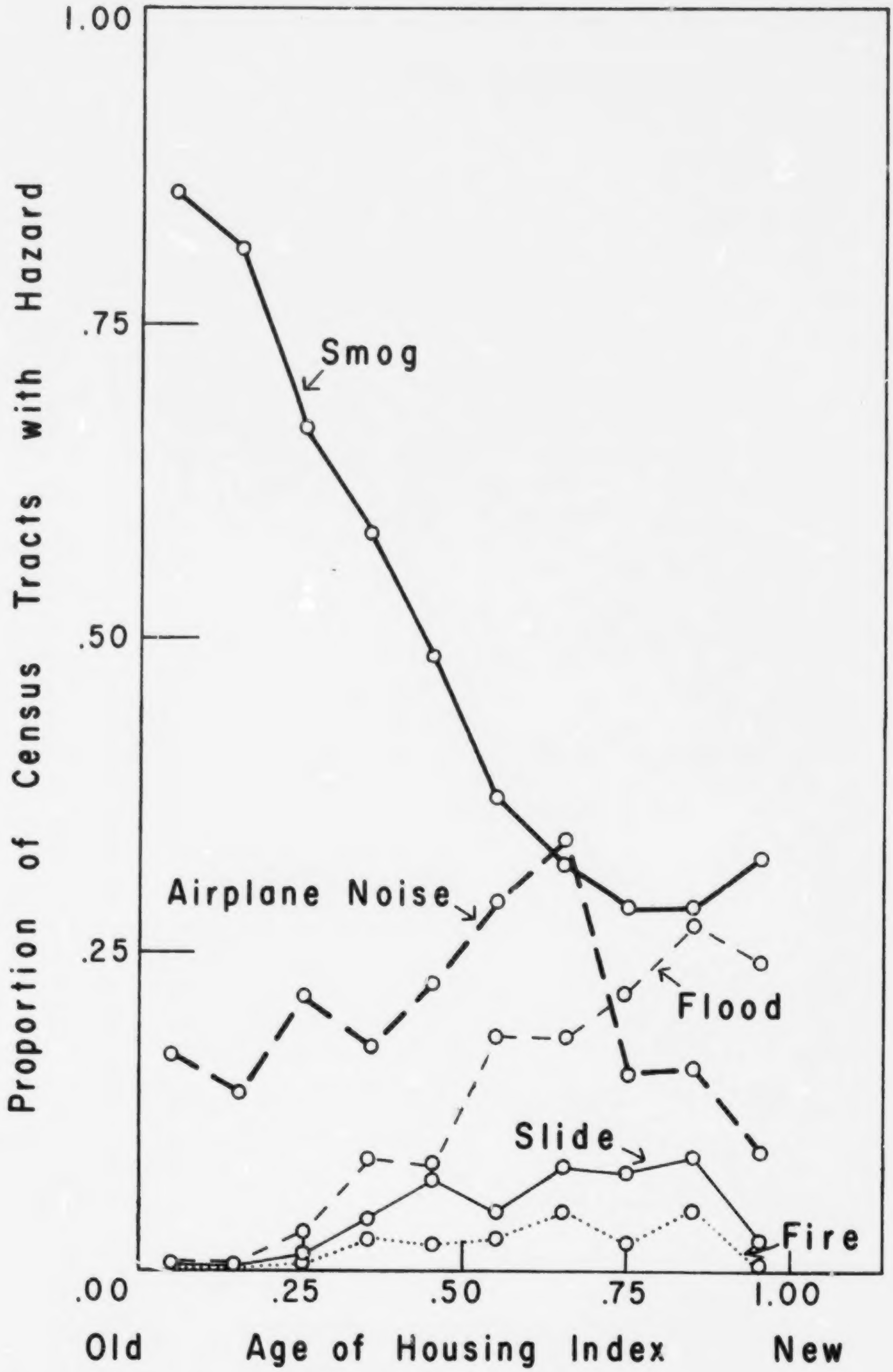
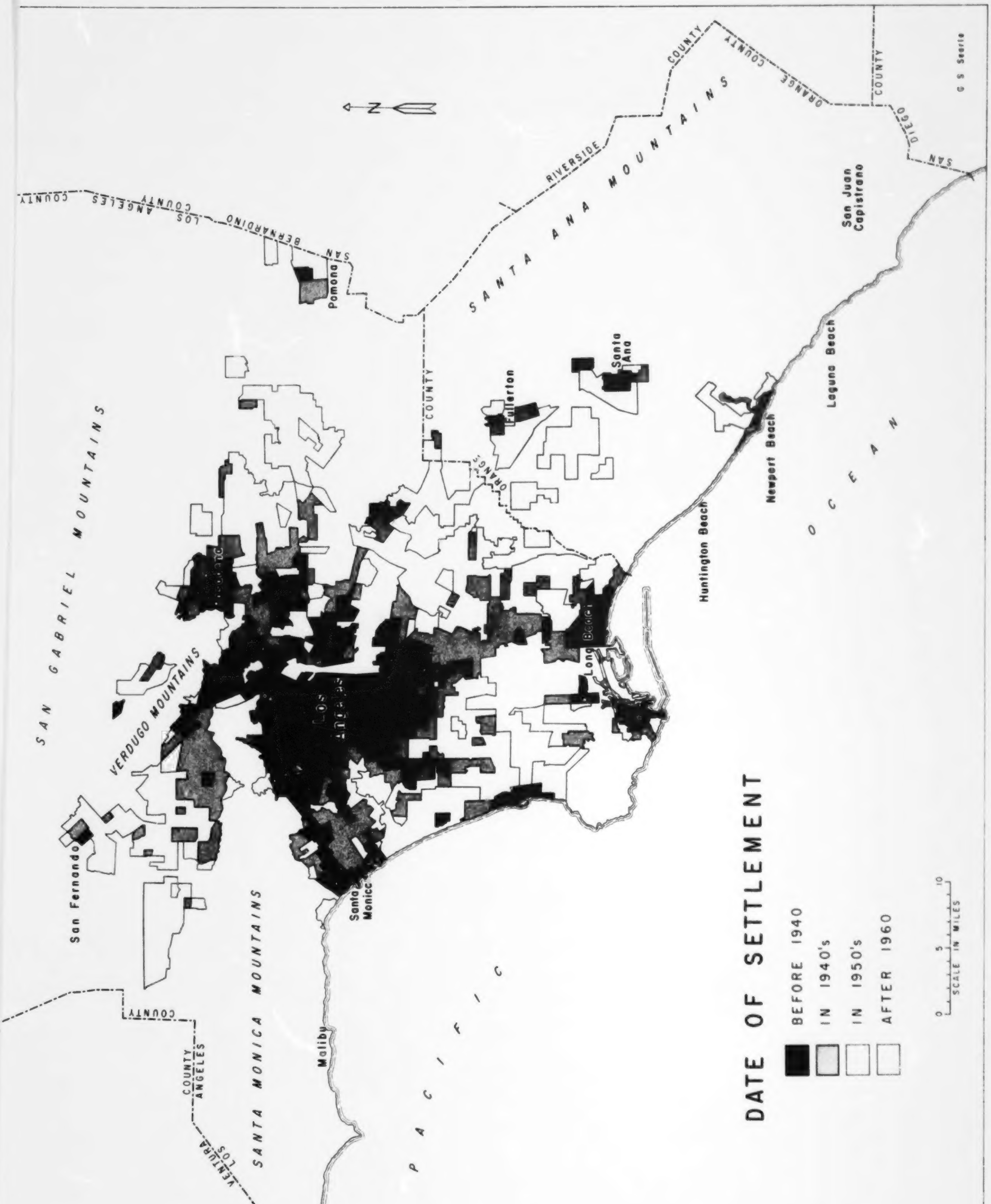


Figure 4 ———Census tracts with hazard present by age of housing index values, Los Angeles Metropolitan Area: 1960

These later tracts are in the San Gabriel valley, as shown in Figure 1, Chapter XII. The likelihood of air traffic noise is highest for housing constructed in the late 1940's, and reflects the proximity of such areas to the Los Angeles International and Burbank Airports. Proportions of tracts with flood are inversely related to the age of housing; as is the tendency for slide and fire.

The pattern of date of settlement for Los Angeles and Orange Counties is shown in Figure 5, as estimated from 1960 census tract data, for the 1401 mainland census tracts. Areas settled prior to 1940 included such outlying cities as San Fernando, Pomona, Fullerton, Santa Ana, Santa Monica, and Long Beach, as well as the central basin of Los Angeles. After 1940 urban settlement coalesced between the basin and a number of outlying communities. In 1960, however, large sections of the Santa Monica, San Gabriel, and Santa Ana Mountains had not obtained a density of two dwelling units per acre. Figure 6 summarizes the spatial associations of the history of urban settlement shown in Figure 5, and artificial and natural hazards as delimited by Figures 2 and 3 in Chapter XII. As shown by Figure 6, percentages of land with artificial and natural hazards are, respectively, directly and inversely related to settlement

Figure 5


DATE OF SETTLEMENT
■ BEFORE 1940
▨ IN 1940's
☐ IN 1950's
☐ AFTER 1960
0 5 10
SCALE IN MILES
N
SAN GABRIEL MOUNTAINS
VERDUGO MOUNTAINS
SANTA MONICA MOUNTAINS
SANTA ANA MOUNTAINS
PACIFIC OCEAN
San Fernando
Santa Monica
Malibu
Los Angeles
Long Beach
Huntington Beach
Newport Beach
Laguna Beach
San Juan Capistrano
Fullerton
Santa Ana
Pomona
VENTURA COUNTY
LOS ANGELES COUNTY
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
ORANGE COUNTY
SAN DIEGO COUNTY
G S Searle

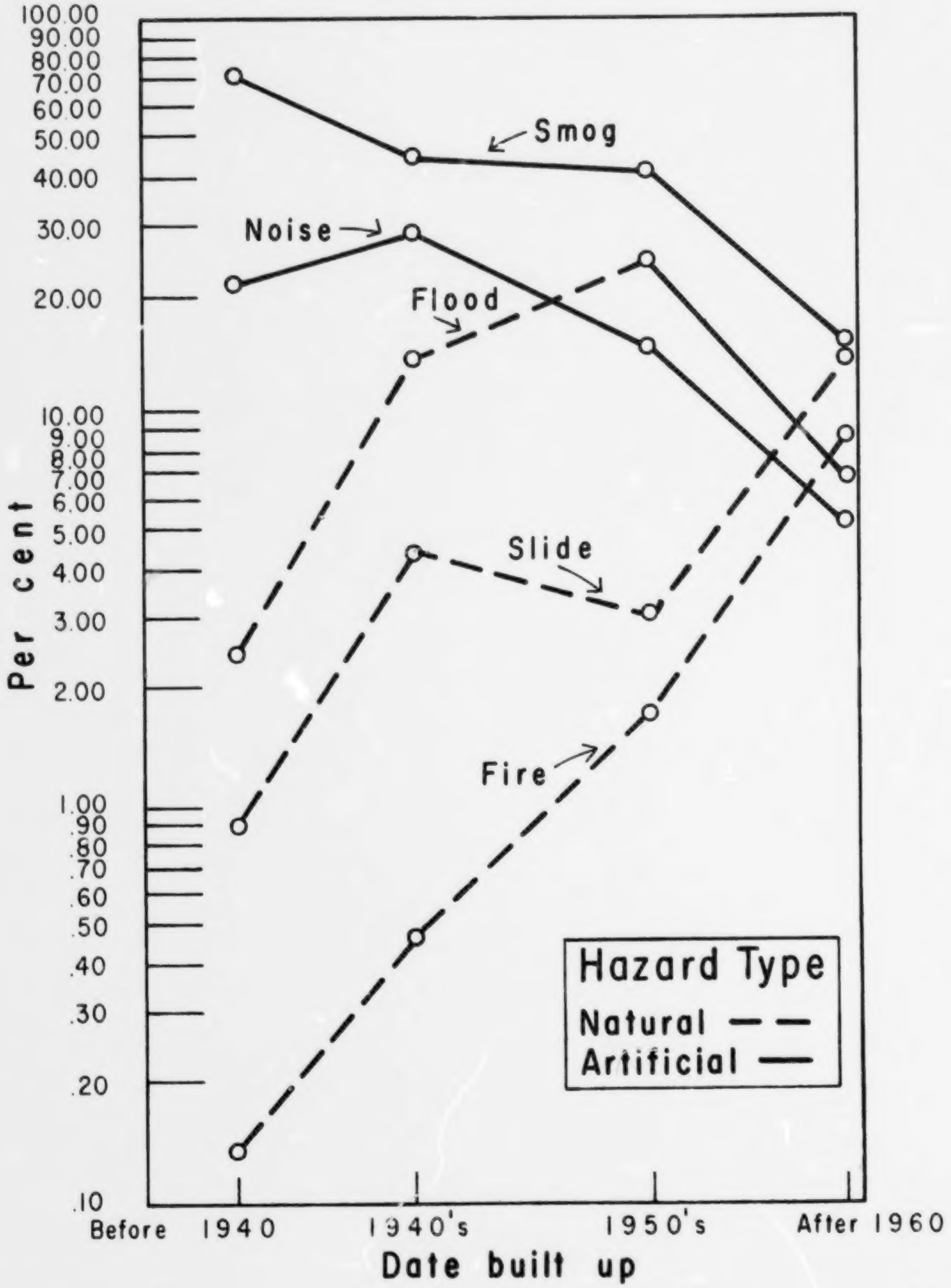


Figure 6 ——— Per cent of areas with "natural" and "artifical" hazards by date built up, County of Los Angeles: 1960

maturation. An important exception is flood, which apparently is intensified some years after settlement, and thereafter declines in prevalence.

Age of housing and date of settlement indexes, while derived from the same data, measure somewhat different aspects of urban development. Both indexes confirm a relationship of differential urbanization to environmental hazard patterning.

Relations of combined housing cycle measures with environmental hazards in 1960.--Differences in population densities, age of housing, and date of settlement in hazard and non-hazard areas show that human alterations of the Los Angeles site, and continued urbanization within the site are associated with environmental hazards. Urbanization pressures will not necessarily generate hazards in the same manner in different metropolitan segments. Interaction of housing cycle components and their relations to hazards may vary from one large metropolitan component to another. With the exception of air pollution information for Los Angeles County, longitudinal hazard data were not obtained for the metropolis. Combined housing cycle components, however, can be related to hazards in 1960, with the caution that it is not possible to extrapolate to longitudinal relations from cross sectional data.

Table 5 describes the multiple census tract correlations of housing cycle measures of age of housing, multiple family dwelling units, and population density, and their beta coefficients (partial regression coefficients in standard form) with each environmental hazard for 1960. No adjustments are made for linearity in the housing cycle measures. The hazard measures, in the form of zero-one intervals, are considered as quantitative variables. Date of settlement was eliminated from consideration as it is not a quantitative measure, and the percentage of commercial, industrial, and transportation land was not used due to its apparent disassociation from the housing cycle. In no case do the housing cycle measures jointly account for more than 17 per cent of the variance of the hazard distributions. In Los Angeles County, the highest multiple correlation coefficient is with smog, with R=.41. The beta coefficients for smog in Los Angeles County on age of housing, multiple family dwelling units, and population density are: (a) age of housing, holding constant multiple family dwelling units and density, -.38; (b) multiple family dwelling units, holding constant age of housing and density, -.01; and (c) density, holding constant age of housing and multiple family

TABLE 5

MULTIPLE CORRELATIONS AND BETA COEFFICIENTS OF AGE OF HOUSING, MULTIPLE FAMILY DWELLING UNITS AND DENSITY WITH ENVIRONMENTAL HAZARDS, LOS ANGELES AND ORANGE COUNTIES: 1960

Hazard		Measure				
		$R_{x.123}$[1]	$R^2_{x.123}$[2]	$\beta_{x(1.23)}$[3]	$\beta_{x(2.13)}$[4]	$\beta_{x(3.12)}$[5]
Smog	Los Angeles County	.41	.17	-.38	-.01	.07
	Orange County	.24	.06	-.09	-.10	.21
Noise	Los Angeles County	.25	.06	.16	-.16	.26
	Orange County	.36	.13	.18	.07	-.31
Flood	Los Angeles County	.26	.07	.15	-.06	-.12
	Orange County	.30	.09	-.20	-.31	-.04
Fire	Los Angeles County	.25	.17	-.09	.02	-.28
	Orange County[6]	--	--	--	--	--
Slide	Los Angeles County	.25	.05	-.04	.03	-.28
	Orange County	.35	.12	-.22	-.18	-.28

[1] Multiple correlation coefficient of hazard on age of housing, multiple family dwelling units, and density.

[2] Coefficient of determination of hazard on age of housing, multiple family dwelling units, and density.

[3] Beta coefficient of hazard on age of housing, holding constant multiple family dwelling units, and density.

[4] Beta coefficient of hazard on multiple family dwelling units, holding constant age of housing and density.

[5] Beta coefficient of hazard on density, holding constant age of housing and multiple family dwelling units.

[6] No fire areas were recorded in Orange County.

dwelling units, .07. In Los Angeles County for 1960, older housing is conducive to smog, while multiple family dwelling units and density are not relevant. For Orange County, the multiple correlation of the three measures with smog is only .24, and density is the one measure that makes an important contribution to smog. This distinction may reflect differences in the average age of the housing stock in the two areas as major urban settlements have appeared more recently in Orange County.

Partial regression coefficients for other hazards also describe inter-county differences. Age of housing makes a negative contribution to air traffic noise in both counties; but contributions of density to air traffic noise are positive in Los Angeles County, and negative in Orange County. These variations suggest that pressures for air traffic patterns are making important inroads on residential air space in Los Angeles County, but that it is still possible to locate traffic patterns in low density areas of Orange County, where urban population does not press so heavily upon the land.

Older housing contributes to flood areas in Los Angeles County, but leads to a lack of floods in Orange County. Brush fire areas are not recorded in Orange County;

density contributes negatively to the presence of brush fires in Los Angeles County. Furthermore, density makes a negative contribution to slide in both counties, as does age of housing, and the proportion of multiple family dwelling units.

While Table 5 describes some similarities in contributions of housing cycle components to hazards in both Los Angeles and Orange Counties, such components apparently interact in a different manner in generating hazards. These contrasts may indicate gross differences in population - organization - environment interaction in these areas; as well as effects of planning and land development policies that have differed during periods of rapid population growth. Topography, airshed locations, highway systems, air traffic patterns, and areas of economic and institutional activity differentiate Los Angeles and Orange Counties. Nevertheless, urban alterations of environmental sites and continued urban land use are apparently related to development of hazards of the type described.

The housing cycle and the genesis of air pollution within Los Angeles County.--Comparative data for 1960 show that environmental hazards are related to site utilization at different stages of the housing cycle. With the exception of air pollution, data were not obtained with which to describe temporal changes in the distribution of Los Angeles hazards. It is possible, however, to relate the 1950 and 1960 pattern of air pollution within Los Angeles County to housing cycle measures for 1940, 1950, and 1960. This description gives a clearer picture of the role of the cycle in air pollution than can be drawn from information for one time point. Data pertaining to housing cycle measures of population density and percentages of multiple family dwelling units were aggregated onto a grid of 480 decennially equivalent census tract combinations comprising Los Angeles County from 1940 to 1960, and compared with air pollution distribution over these tract combinations in 1950 and 1960. The age of housing measure, which is relevant only to 1960, and the date of settlement index, which is not amenable to the mode of analysis utilized, were here eliminated from consideration.

If urban settlement generates smog, population density and multiple family housing should be more of a precursor than a concomitant of smog. Furthermore, to the extent that air pollution culminates urban development, decreasing rates of increase in population density and percentages of multiple family dwelling units should be observed over time in polluted areas. Relations of the housing cycle to air pollution are thus expected to change in the direction of less association. Moreover, as population density is more closely associated with non-residential uses of the environment, density should make a greater contribution to air pollution than multiple family housing.

Air pollution has a long history in Los Angeles. It was, however, not generally recorded until approximately 1950. While the spatial distribution of the photochemical index of air pollution used in this research was stable between 1950 and 1960, internal changes in oxidant levels within delimited smog areas undoubtedly occurred. Smog was treated as a zero-one interval variable for the analysis. If the assumptions specified above are correct, contributions of density or multiple family housing in 1940 to smog in 1950 should be greater than contributions of these measures in 1950 to smog in 1960, or their 1960 contributions to 1960 smog. Density should make a greater contribution to smog at the same and subsequent dates than multiple family housing. Furthermore, 1940 density should have more influence on 1950 smog than 1950 density, and 1950 density should have more influence on 1960 smog than 1950 density. Similar relations are expected for conterminous and time lagged contributions of multiple family housing to air pollution.

Zero order and multiple census tract correlations and partial standardized beta coefficients of density and multiple family dwelling units on smog in Los Angeles County are described in Table 6. Zero order correlations of 1950 and 1960 smog with density in 1940, 1950, and 1960 were .35, .35, and .27 respectively; comparable correlations with proportions of multiple family dwelling units were .19, .18, and .13. (These correlations are not shown in Table 6.) The associations of density and multiple family dwelling units with smog declined over time, as expected. Smog presence in neighborhoods lags environmental alterations reflected by individual housing cycle measures. In no instance, however, did a single index account for more than twelve per cent of the variable of subsequent or current air pollution.

Table 6 also indicates that, with the exception of 1950, air pollution lags neighborhood changes related to the combined intrusion of population and multiple family housing. Furthermore, beta coefficients describing the influence of prior or current densities and proportions of multiple family dwelling units on smog, indicate that the major contributions are made by density. Table 6 further

TABLE 6

MULTIPLE CORRELATIONS AND BETA COEFFICIENTS OF DENSITY AND MULTIPLE FAMILY DWELLING UNITS WITH AIR POLLUTION LOS ANGELES COUNTY: 1940-1960

Comparison	Measure			
	Rx.12.n[1]	R^2x.12.n[2]	βx1.2[3]	βx2.1[4]
Density and MFDU's 1940 on smog 1950	.36	.13	.46	-.15
Density and MFDU's 1950 on smog 1950 and smog 1960	.35	.12	.39	-.06
Density and MFDU's 1960 on smog 1960	.24	.07	.27	.00
Density 1940 and 1950 on smog 1950 and smog 1960	.33	.11	.18	.18
Density 1950 and 1960 on smog 1950 and smog 1960	.36	.13	.55	-.22
MFDU's 1940 and 1950 on smog 1950 and smog 1960	.20	.04	.12	.08
MFDU's 1950 and 1960 on smog 1950 and smog 1960	.14	.03	.24	-.07
Density 1940, 1950, and 1960 on smog 1960	.36	.13		
MFDU's 1940, 1950, and 1960 on smog 1960	.20	.04		

[1] Multiple correlation coefficient of specified predictor variables on smog.

[2] Coefficient of determination of specified predictor variable on smog.

[3] Beta coefficient of first specified predictor variable on smog, holding constant second predictor variable.

[4] Beta coefficient of second predictor variable on smog, holding constant first predictor variable.

separately summarizes the current and time lagged influences of density and multiple family housing on smog. The beta coefficients of 1940 and 1950 density with smog in 1950 and 1960, holding constant density in 1940 or 1950, show that the 1940 and 1950 density contributions to smog are approximately equal. A similar density comparison for 1950 and 1960 indicates that the positive contribution to 1960 smog is by prior rather than current density, which makes a negative contribution to smog in 1960. Similar, though less pronounced findings are observed for influences of multiple family housing on smog. The negative contributions of 1960 density and multiple family housing to 1960 smog, suggest that differential population growth favoring smog free areas was occurring by 1960. A historical pattern of urban settlement within Los Angeles appears to be a more important generator of air pollution than the current state of land use. This finding is further confirmed by the relatively low multiple correlation of 1940, 1950, and 1960 density and multiple family dwelling units with 1960 air pollution.

Urban development contributes to air pollution in terms of the assumptions here specified. Smog is a concomitant of later stages of urban development. The impact of components of the housing cycle on smog, however, cannot be clearly defined; the data presented in Tables 5 and 6 should be regarded as hypotheses rather than as generalizations. Spatial boundaries of settlement within the metropolis are determined by accessibility to employment centers, topography, land development technology, and land use economics.[13] For the regression weights presented to have high descriptive power, the relevant metropolis must be defined in terms of these factors, or the analysis repeated for other metropolitan areas. Nevertheless, the housing cycle, as measured in this research, does make a significant contribution to the development of air pollution in Los Angeles.

Environmental Hazards and Urban Social Structure

The census tract distribution of environmental hazards in Los Angeles in 1960 was related to a series of social and demographic indexes that are traditional to human ecology. While these criterion variables were selected in a somewhat arbitrary manner, they have been used in previous research to describe social and demographic characteristics of urban subareas.[14] Indexes of data from the 1960 U. S. Census of Population and Housing were used to delimit census tract characteristics descriptive aspects of housing unit value, urbanism, familism, ethnicity, and residential mobility for 1960. Measures of housing unit value were obtained from census tract measures of median home value and median contract rent. A child-women ratio based on the number of children under five years of age per 100 females in the childbearing years of fifteen to forty-four was used to indicate census tract level of familism. The percentages of females fourteen or more years of age in the labor force described the level of urbanism of the tracts. Ethnicity was indicated by the percentages of the tract populations that was Negro. Residential mobility was specified by the percentages of tract populations that had changed their places of residence from 1955 to 1960.

Table 7 shows the product moment correlations of census tract hazard levels with the social and demographic characteristics of the 1403 census tracts for the Los Angeles Standard Metropolitan Statistical Area in 1960. The hazard measures, while representing ranks, were treated as quantitative variables. No adjustments for linearity were made with the data, and the .05 level of significance was used as a basis for evaluating the correlations. There was some linear relationship between the environmental hazards and the characteristics of the urban subarea populations. For

TABLE 7

ZERO ORDER CORRELATIONS[1] OF ENVIRONMENTAL HAZARDS WITH SELECTED SOCIAL AND DEMOGRAPHIC CHARACTERISTICS OF URBAN SUBAREAS LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA: 1960

Variable Class	Index	Hazards				
		Health Hazards		Economic Hazards		
		Smog	Air Traffic Noise	Brush	Flood	Slide
Housing Unit Value	Home value	-.15	-.07	.25	.02	.24
	Rent	-.26	-.03	.25	.05	.22
Urbanism	Females in the labor force	.22	.03	-.06	-.13	-.11
Familism	Child-women ratio	-.10	.09	-.11	.17	-.07
Ethnicity	Per cent Negro	.10	.23	-.05	-.10	-.08
Residential Mobility	Per cent movers 1955-1960	.12	.06	.00	-.14	-.00

---

[1] $r = \pm .05$ significant at .05 level.

smog there was a negative relationship with median home value (-.15) and median contract rent (-.20). Relations of airplane noise with home value were significant (-.07) but were effectively zero with median rent (-.02). Association of brush fires and slides with home value were .25 and .24, respectively, while the comparable relation with median rent were .25 and .22. The correlations of flood with home value and rent were effectively zero. It appears that there is a tendency for smog to be negatively related to housing unit value, while the economic hazards of brush fires and slides are characteristic of higher housing unit value areas.

Urbanism, as measured by females in the labor force, was positively correlated with smog (.22), unrelated to airplane noise, and negatively related to brush fire, flood and slide with correlations of -.06, -.13, and -.11, respectively. Familism, indicated by the child-women ratio, was negatively related to smog (-.10), positively related to flood (.17), negatively related to brush fires (-.11) and slide (-.07). With respect to ethnicity, the proportion of Negro population was positively associated with smog (.10) and airplane noise (.23), and negatively associated with brush fires (-.06), flood (-.11), and slide (-.08).

Mobility was positively related to smog (.12) and airplane noise (.06), and negatively related to flood (-.15).

In summary, artificial or health hazards tended to characterize lower social economic level populations, and economic or natural hazards were more characteristic of higher social economic level areas. The urbanism of census tract areas was positively related to smog, and showed a slight negative relationship with economic hazards. Analyses of the covariation of familism with the hazards yielded mixed results, and ethnic populations as defined had a slight tendency to be located in health hazard areas but not in areas of economic hazards.

Environmental hazards as a possible intervening variable in the differentiation of urban social structure. While air pollution in Los Angeles is a residue of urban settlement, the relative importance of the housing cycle and air pollution as differentiators of the ecological structure of Los Angeles remain to be demonstrated. Although one cannot generalize from cross sectional to longitudinal relationships, the age of housing index and smog level were related simultaneously to the selected social and demographic characteristics of urban subareas. Table 8 shows the multiple correlations of the housing cycle and smog level

TABLE 8

MULTIPLE CORRELATIONS AND BETA COEFFICIENTS OF AGE OF HOUSING AND SMOG WITH SELECTED SOCIAL AND DEMOGRAPHIC CHARACTERISTICS OF URBAN SUBAREAS LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA: 1960

Variable Class	Index	$R^2_{1.23}$[1]	$R_{1.23}$[1,2]	$\beta_{12.3}$	$\beta_{13.2}$
Housing unit value	Home value	.06	.25	.22	-.05
	Median rent	.15	.38	.32	-.12
Urbanism	Females labor force	.10	.32	-.26	.10
Familism	Child-woman ratio	.08	.28	.29	.03
Ethnicity	Per cent Negro	.11	.34	-.36	-.05
Residential mobility	Per cent movers 1955-1960	.05	.23	-.22	.02

[1] r = .054 significant at .05 level.

[2] 1 = criterion variable.

2 = age of housing index.

3 = smog level.

with the social and demographic characterisitcs of subareas in the Los Angeles metropolitan area. Also indicated is the contribution made by each predictor variable to the explained variance in the criterion measures as expressed by beta or partial regression coefficients in standard score form. (The zero order correlation coefficients of age of housing and smog level with the criterion measures were shown in Table 7.) With respect to housing unit value, the multiple correlation of home value with the two predictors was .25; beta coefficients of home value were: (a) age of housing, holding constant smog, .22; and (b) smog, holding constant age of housing, -.05. The multiple correlation of the two predictors with median rent was .38, and the beta coefficients of median rent were: (a) age of housing, holding constant smog, .32, and (b) smog, holding constant age of housing, -.12. A similar pattern of correlations and beta weight contributions were found with respect to the fertility ratio. With respect to the urbanism, ethnicity, and mobility measures, the beta coefficients of age of housing, holding constant smog, were all negative, and roughly of the same size level as those reported above. The only other beta that was not effectively zero for smog holding constant age of housing was for the urbanism measure (.10). A low age of housing contributed to high housing unit value, high familism, and to low urbanism, low ethnicity, and low mobility. High smog contributed to low median rent and to a high proportion of females in the labor force. The contributions of smog to the explanation of the criteria were generally less than one-third of the contributions of the age of housing index. These generally negative results do not indicate that smog is an intervening variable in the social and economic differentiation of urban subareas. It is emphasized, however, that these analyses have been based on comparative instead of longitudinal data, on linear correlations, and that the measures considered have not been adjusted for linearity.

Air Pollution and Population Redistribution within the County of Los Angeles

Redistribution effects of air pollution. Given the indications that differential urbanization within the Los Angeles metropolis is associated with the pattern of environmental hazards, it remains to be demonstrated that hazards play a role in activating population growth away from affected hazard sites. Census data and estimates concerning the presence and absence of smog were grouped for the grid of 480 decennially equivalent census tract combinations comprising the total area of the County of Los Angeles in 1940, 1950 and 1960. Intrametropolitan urbanization, as indicated by neighborhood stages of maturation in the Hoover-Vernon urban housing cycle, was crudely described by classifying "cohorts" of tract combinations by the two dwelling unit per gross acre density criterion as of the three census dates, thus facilitating cohort comparisons at the same and different points in time.[15] Outlines of the relations between county population, land area, dwelling units, and air pollution from 1940 to 1960 are summarized in Table 9 and Figure 7. By 1950 the intrusion of smog into 27.7 per cent of the county area had affected 60.7 per cent of the county population by place of residence. While the population living in smog areas increased by approximately one-half million during the next ten years, increases of more than one and one-third million persons meant that only 50.4 per cent of the resident population was exposed to smog in 1960. Consistent increases in the spatial extent, population, and housing units of built-up areas occurred during the twenty years, but the addition of new urban (built-up) land resulted in density decreases in built-up areas from 1940 to 1960, while densities concurrently increased in non-built-up

TABLE 9

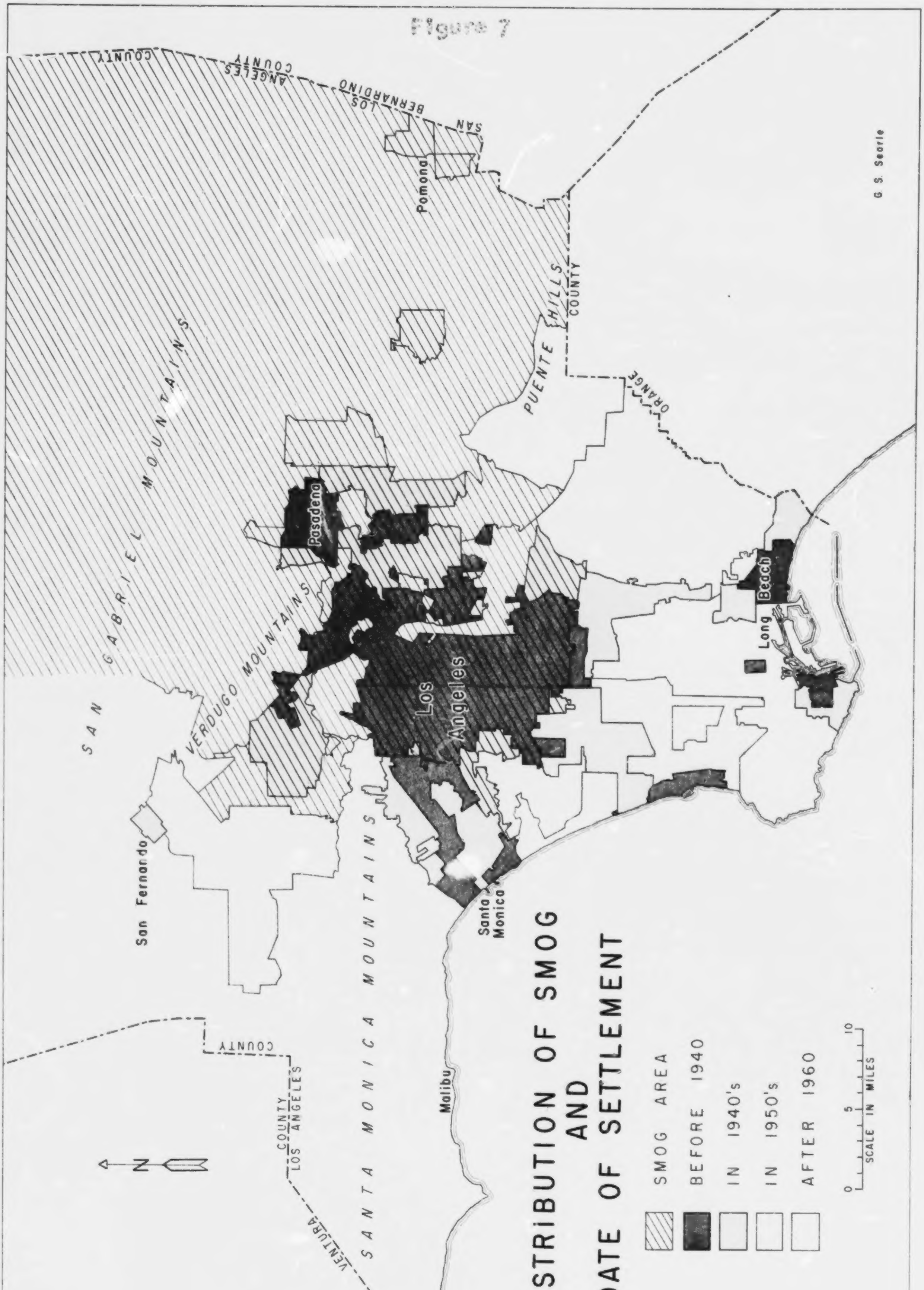
POPULATION, DWELLING UNITS, LAND AREA, AND POPULATION PER GROSS ACRE BY SETTLEMENT AREA AND AIR POLLUTION PRESENCE, COUNTY OF LOS ANGELES: 1940-1960[1]

Measure	Years		
	1940	1950	1960
County Population (000's)	2790.1	4152.0	6036.0
% in Built up Areas	62.3	67.6	75.3
% in Smog Areas	---	60.7	50.4
County Dwelling Units (000's)	961.3	1443.8	2142.7
% in Built up Areas	65.1	70.0	78.8
% in Smog Areas	---	61.6	53.6
County Land Areas in Acres (000's)	2551.3	2551.3	2551.3
% in Built up Areas	4.2	8.1	15.0
% in Smog Areas	---	27.7	27.7
County Population Per Gross Acre			
In Built up Areas	16.3	13.6	12.6
In Non-Built up Areas	.4	.6	.7
In Smog Areas	---	3.6	4.3
In Non-Smog Areas	---	.9	1.6

---

[1] Analysis for this table is based on 480 tract combinations. The area includes river courses, reservoirs and lakes. Population and dwelling unit totals are summed from census tract data and do not balance exactly with published totals in census reports. Data are not comparable with Table 1, as the 480 census tract allocations result in differences in the tract allocation of air pollution.

Figure 7



DISTRIBUTION OF SMOG AND DATE OF SETTLEMENT

▨ SMOG AREA
■ BEFORE 1940
☐ IN 1940's
☐ IN 1950's
☐ AFTER 1960
0 5 10
SCALE IN MILES
N
SAN GABRIEL MOUNTAINS
VERDUGO MOUNTAINS
SANTA MONICA MOUNTAINS
PUENTE HILLS
San Fernando
Pasadena
Los Angeles
Pomona
Long Beach
Santa Monica
Malibu
LOS ANGELES COUNTY
SAN BERNARDINO COUNTY
ORANGE COUNTY
VENTURA COUNTY
G. S. Searle

areas, and--from 1950 to 1960--in both smog and non-smog areas.

Figure 8 indicates changing population densities from 1940 to 1960 by date of settlement neighborhood cohorts in smog and non-smog areas, controlling for intracohort differences in housing unit size. While employment accessibility is not regulated, settlement densities from 1950 to 1960 increased more rapidly in non-smog than in smog areas, within the cohorts settled after 1960, in the 1950's and in the 1940's. Furthermore, there was a density decrease in the total and in the smog segment of the before 1940's cohort from 1950 to 1960, while density in the non-smog portions of this cohort continued to increase. These results may be influenced, in part, by the inverse relation of population density to subsequent growth, as the non-smog areas, with the exception of the 1940's cohort, were less densely settled in 1950. Nevertheless, the non-smog portion of the 1940's cohort had obtained a higher population density than the smog portion in 1950, and yet continued to increase more rapidly than the smog portion in the following decade.

Data from Figure 8 and Table 9 suggest 1950 to 1960 population and dwelling unit increases favoring non-smog

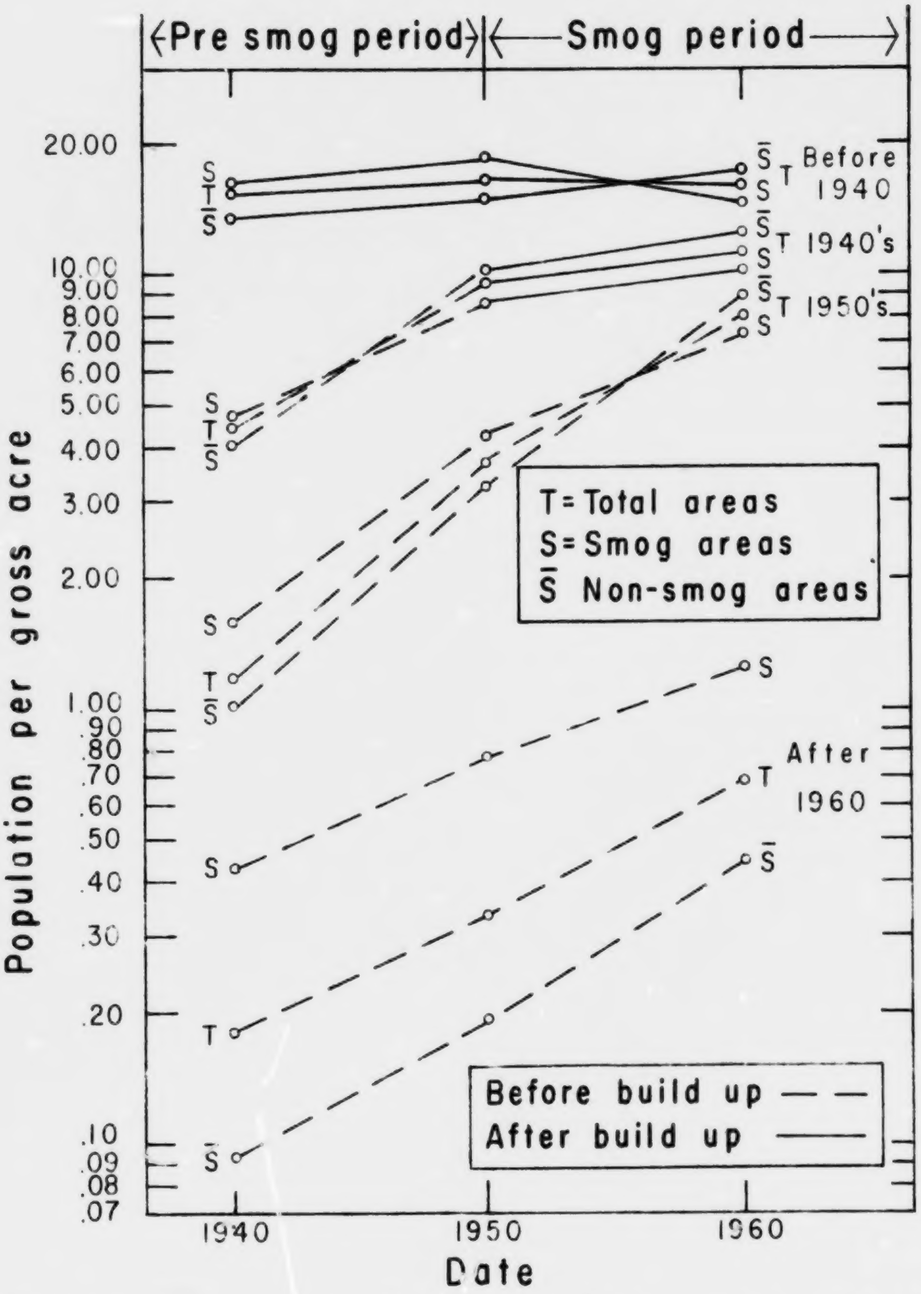


Figure [illegible]——Population per gross acre by date built up and presence or absence of smog, County of Los Angeles: 1940–1960 instead of smog areas. Dependence of air pollution upon urban development, and 1950 to 1960 population redistribution to new neighborhoods at the periphery of the metropolis, however, may mean that smog exposure changes are accounted for by the growth of the city. In this respect, it is assumed that the majority of the 1950 to 1960 decrease in the proportion of the population exposed to smog is a function of redistribution to outlying suburban areas at earlier stages of settlement maturation. Changes in smog exposure are not seen as the result of redistribution to smog free areas at the same stage of the housing cycle, or at the same commuting distance from the central city. On the other hand, given an awareness of smog, differential resources, employment accessibility, and limited residential locational opportunities of the population of Los Angeles, it was assumed that 1950 to 1960 smog exposure reductions would be greater for non-Negroes than for Negroes, white collar than for blue collar workers, younger than for older populations, single family than for multiple family dwelling units, and owner occupied than for renter occupied dwelling units.

To test these assumptions, 1950 and 1960 comparisons were made of the percentages of the above categories exposed to smog, and 1960 expected percentages exposed to smog assuming that the populations of the categories increased as recorded from 1950 to 1960, but that the 1960 percentage exposures of the categories within each date of settlement cohort and each of three distance zones from the civic center remained constant.[16] These comparisons indirectly control for density, which has been previously shown to be a precursor rather than a concomitant of smog; and directly control for date of settlement, and for distance from the central city as measured by rings around the civic center, drawn at distances of seven and one half and fifteen miles. In Table 10, line (1) indicates the percentage of a category exposed to smog in 1950 and line (2) shows the 1960 respective exposure percentage. Line (3) indicates the expected 1960 percentage exposure based on the summation of the product of the total 1960 population in each date of settlement cohort and distance ring combination multiplied by the proportion of the population in each cohort exposed in 1950. Line (4) specifies the percentage exposure reductions affected by shifts to different date of settlement areas and distance zones, and line (5) indicates the effects of other changes, including smog. Proportionate and total effects are shown by lines (6), (7), and (8).

TABLE 10

SMOG EXPOSURE OF POPULATIONS AND DWELLING UNITS, CONTROLLING FOR INFLUENCE OF DATE OF SETTLEMENT COHORTS AND DISTANCE FROM CIVIC CENTER, COUNTY OF LOS ANGELES: 1950-1960

Exposure	Population			Occupation			Age	
	Total	Non-Negro	Negro	Total	White Collar	Blue Collar	-15	65+
Observed and Expected Exposure								
(1) 1950 % exposed to smog	60.7	59.9	75.4	63.5	64.2	62.7	53.8	68.0
(2) 1960 % exposed to smog	50.4	48.8	69.9	52.2	51.3	53.1	45.9	61.1
(3) 1960 expected % exposed to smog	52.1	50.4	69.6	53.9	54.6	53.3	46.3	63.3
(4) Influence of date of settlement and distance: (3)-(1)	- 8.6	- 9.5	- 5.8	- 9.6	- 9.6	- 9.4	- 7.5	- 4.7
(5) Influence of other factors including smog: (2)-(3)	- 1.7	- 1.6	+ 0.3	- 1.7	- 3.3	- 0.2	- 0.4	- 2.2
% Change 1950-1960 due to:								
(6) Change to date of settlement: (4)/(1)	-14.2	-15.9	- 7.7	-15.1	-15.0	-15.0	-13.9	- 6.9
(7) Other factors: (5)/(1)	- 2.8	- 2.7	+ 0.4	- 2.7	- 5.1	- 0.3	- 0.7	- 3.2
(8) Total: (6)+(7)	-17.0	-18.6	- 7.3	-17.8	-20.1	-15.3	-14.6	-10.1

TABLE 10--Continued

Exposure	Dwelling Units			Occupied Dwelling Units		
	Total	Single	Multiple	Total	Owner	Rental
Observed and Expected Exposure						
(1) 1950 % exposed to smog	61.6	58.4	67.9	62.4	58.4	67.3
(2) 1960 % exposed to smog	53.6	50.1	61.6	53.6	47.6	60.7
(3) 1960 expected % exposed to smog	55.2	51.7	67.6	55.5	49.4	62.0
(4) Influence of date of settlement and distance: (3)-(1)	- 6.4	- 6.7	- 4.3	- 6.9	- 9.0	- 5.3
(5) Influence of other factors including smog: (2)-(3)	- 1.6	- 1.6	- 2.0	- 1.9	- 1.8	- 1.3
% Change 1950-1960 due to:						
(6) Change to date of settlement: (4)/(1)	-10.4	-11.5	- 6.3	-11.1	-15.4	- 7.9
(7) Other factors: (5)/(1)	- 2.6	- 2.7	- 2.9	- 3.0	- 3.1	- 1.9
(8) Total: (6)+(7)	-13.0	-14.2	- 9.2	-14.1	-18.5	- 9.8

Table 10 shows, that, the assumption that the major portion of the 1950 to 1960 percentage decrease in population exposure to smog in Los Angeles County can be accounted for by population redistribution between date of settlement and distance ring areas is substantiated for the total population of Los Angeles County and each of its evaluated ethnicity, occupational, age, and dwelling unit categories. For example, the first data column of the table denotes an observed population exposure to air pollution of 60.7 per cent in 1950 and 50.4 per cent in 1960, and specifies expected exposure in 1960 as 52.1 per cent. The assumed model of urban aggregation and expansion thus tends to overestimate slightly the percentage of the total population exposed to air pollution in 1960. On the other hand, the model accounts for 84 per cent of the percentage reduction in smog exposure from 1950 to 1960, as is indicated by dividing the entry in row (4) by the sum of the entries in rows (4) and (5). Only 14 per cent of the net percentage exposure reduction can be accounted for by other factors, including smog. Of the net 1950 to 1960 increment of 830,400 more persons exposed to smog than not exposed, 697,500 occurred in different date of settlement and distance ring areas. Within Los Angeles County from 1950 to

1960, percentage reductions in the smog exposure of the total population can be accounted for largely by population redistribution to newer areas and/or areas which are located at increased commuting distance from the central city.

The assumption that smog exposure reductions would be greater for non-Negroes than for Negroes, white collar than for blue collar workers, younger than for older populations, single family than for multiple family dwelling units, and owner occupied than for renter occupied dwelling units were verified for each comparison. For each of the above categories, the model of aggregation and expansion accounts for no less than 68 per cent of the smog exposure reduction, and explains more than 95 per cent of the smog exposure reduction for the blue collar occupational category and for Negro population. While normal processes of urban growth and development appear to be now accounting for reductions in the percentages of the population exposed to smog, changes in the face of smog apparently differ by contrasting populations and functions. These disparities suggest that different populations may perceive smog in divergent ways, and subsequently not plan to move away from smog areas, or else implement moving decisions that are, in part, based on considerations of air pollution in the neighborhoods from which moves originated.

Air pollution and neighborhood change.--Air pollution does not appear to be a major influence in population redistribution in Los Angeles County, which can be accounted for largely by processes of urban aggregation and expansion. Nevertheless, the question remains as to whether air pollution is associated with changes in home values and the ethnic composition of affected neighborhoods. A simple consideration of this question would suggest comparisons over time of home values and ethnic populations in smog and non-smog areas. Such collating, however, would not indicate the simultaneous effects of changes in population densities, or of the other variable not examined. A description of effects of air pollution on the downgrading, and the filtering down of urban neighborhoods to new populations can be obtained by comparing the relations of white collar employment, home values, ethnic composition, and density, over time, in smog and non-smog areas. In this respect, a lack of downgrading is evidenced by positive associations between changes in white collar employment and home values. Positive relations between changes in census tract percentages of Negro population and ranked home values, white collar workers, and population density would indicate a filtering down process of housing to a new population that is not associated with downgrading. If the relations of the changes in the above variables are more positive or less negative in smog than in non-smog areas, air pollution may be associated with context in which there is a filtering down of new ethnic categories to affected areas, or a downgrading of land use.

Relations between white collar employment, home value, density, and Negro population measures were compared, for smog and non-smog areas, for 1940, 1950, and 1960, on a cross sectional, interannual, and time-lag basis, and a correlation of "deviational change" was used to measure the congruences of changes in one variable with changes in a second variable.[17] The analysis describes association of the values of any two variables at any one of the three given time points, and between any two of the time points; as well as the association of a variate over time.[18] Cross sectional product-moment correlations specify the associations of values for any two variables at one time point. Interannual correlations indicate the associations of values of a variate between two points in time. Lag correlations measure the associations of values of any two variables between two points in time. Deviational change correlations, which indicate relative velocities of change of any two variables, portray the association of change in one variable with change in another variable between two time points.[19] Table 11 abstracts the census tract cross sectional, interannual, lag, and deviational change correlations for ranked percentage of white collar workers and ranked home values; and for percentage of Negro population with ranked home value, ranked percentage of white collar workers, and population density per gross acre. These comparisons are individually presented for the periods from 1940 to 1950, and from 1950 to 1960, for smog and non-smog areas.

The first section of Table 11 summarizes associations of the ranked percentages of white collar workers and the ranked values of owner occupied housing units from 1940 to 1950, and from 1950 to 1960. For both 1940 and 1950 the cross sectional correlations were effectively zero in both smog and non-smog areas. Interannual correlations were low for the 1940 to 1950, and 1950 to 1960 time periods, indicating census tract instability over time of ranked home values and ranked percentages of white collar workers. This instability likely mirrors the construction of new residential communities at different home value levels, and the

TABLE 11

CROSS SECTIONAL, INTERANNUAL, LAG, AND DEVIATIONAL CHANGE CORRELATIONS FOR SELECTED MEASURES, BY SMOG AND NON-SMOG AREAS, COUNTY OF LOS ANGELES: 1940-1960

Measures	Time	Cross Sectional Correlations			Interannual Correlations			Lag Correlations			Deviational Change Correlations	
		Type	Smog	No Smog	Type	Smog	No Smog	Type	Smog	No Smog	Smog	No Smog
Ranked % white collar workers and ranked home value	1940-1950	W_1O_1	-.07	.07	W_1W_2	-.22	-.20	W_1O_2	-.02	-.03	.02	-.05
		W_2O_2	.04	-.04	O_1O_2	-.16	-.15	W_2O_1	-.03	-.05		
	1950-1960	---	---	---	W_2W_3	-.16	-.20	W_2O_3	.01	-.04	.02	.12
		W_3O_3	.01	.13	O_2O_3	-.12	.00	W_3O_2	.02	.14		
% Negro and ranked home value	1940-1950	N_1O_1	.06	.01	N_1N_2	.87	.84	N_1O_2	.04	-.17	-.06	-.02
		N_2O_2	-.01	-.15	O_1O_2	-.16	-.15	N_2O_1	.09	-.02		
	1950-1960	---	---	---	N_2N_3	.76	.86	N_2O_3	.00	-.12	-.02	-.03
		N_3O_3	-.01	-.12	O_2O_3	-.12	.00	N_3O_2	-.03	-.13		
% Negro and ranked % white Collar workers	1940-1950	N_1W_1	.07	.05	N_1N_2	.87	.84	N_1W_2	.12	.11	.04	.12
		N_2W_2	.11	.16	W_1W_2	-.22	-.20	N_2W_1	.04	.03		
	1950-1960	---	---	---	N_2N_3	.76	.86	N_2W_3	-.44	-.40	-.35	-.28
		N_3W_3	-.56	-.49	W_2W_3	-.16	-.20	N_3W_2	.07	.14		
% Negro and population density	1940-1950	D_1N_1	.09	.08	D_1D_2	.97	.93	D_1N_2	.15	.09	.16	.16
		D_2N_2	.22	.20	N_1N_2	.87	.84	N_1D_2	.15	.17		
	1950-1960	---	---	---	D_2D_3	.87	.95	D_2N_3	.23	.22	.24	-.11
		D_3N_3	.25	.23	N_2N_3	.76	.86	N_2D_3	.16	.23		

---

[1] Correlation types are indicated as follows: W = ranked value of per cent white collar workers, O = ranked value of owner occupied housing units, N = per cent Negro, D = density per gross acre, $_1$ = 1940, $_2$ = 1950, $_3$ = 1960.

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in-movement of diverse occupational categories. Low lag correlations show little influence of one variable upon another at a different time point. The correlation of deviational change reflects little association in the velocity of change in the two characteristics over the two ten year periods. For non-smog areas, however, there is a change from a low negative relationship between home value and occupation from the 1940-1950 period, prior to the intrusion of smog into Los Angeles, to a low positive relationship from 1950 to 1960, after smog became prevalent in the metropolis.

The second section of Table 11 portrays the associations for percentage Negro and ranked value of owner occupied dwelling units. Cross sectional relations, though generally negative, are quite small. Interannual relations indicate--in both smog and non-smog areas--high stability of Negro population distribution from 1940 to 1950 and from 1950 to 1960, in contrast to the instability of the home value index. Lag relations are generally greater in smog than in non-smog areas, and the correlations of deviational change indicate little congruence between changes in these characteristics in either smog or non-smog areas, from 1940 to 1950 or from 1950 to 1960.

Associations of the Negro population and occupation measures are shown in the third section of Table 11. Prior to the intrusion of smog in 1950, there were small cross sectional and lag correlations as well as small interannual correlations for the white collar workers in both smog and non-smog areas. By 1960, the changes in these relations suggest that the merging of Negro populations and blue collar occupational status are slightly more important in smog than in non-smog areas. From 1950 to 1960 cross sectional correlations for these measures changes from low positive relations to high negative relations and the associations were somewhat higher in smog than in non-smog areas (-.56 compared with -.49). Relatively high interannual correlations were found for the percentages of Negroes in tracts for the period, while low correlations were found for the proportions of white collar workers. The proportion of white collar workers negatively lagged percentages of Negro population 1950 to 1960. From 1950 to 1960, the correlation of deviational change was larger for smog than for non-smog areas. These changes suggest that blue collar worker concentrations are more associated with increases in Negro population in smog than in non-smog areas.

The last section of Table 11 indicates the associations of Negro population and density per gross acre. The cross sectional associations show that the association has been increasing in both smog and non-smog areas from 1940 to 1950 and from 1950 to 1960. The interannual correlations suggest a high consistency of relations for both measures for the two ten year periods. The lag correlations are of roughly the same level in smog and non-smog areas. Correlations of deviational change, however, show that the velocity of the associated changes of Negro population and population density is greater in the more centrally located smog areas than in the more outlying non-smog areas.

These limited data suggest, that, after the intrusion of smog into residence areas, the relations between changes in Negro population and white collar population are negative, and between Negro population and population density are positive. With respect to the occupational characteristics of all areas, the Negro population increases are associated with a downward trend in occupational status. Nevertheless, increased population densities are positively associated with increased percentages of Negroes in smog areas, while increases in densities in non-smog areas have been negatively related to increases in Negro population since 1950. These relationships do not show that smog contributes to ethnic change or to downgrading of the residential and occupational character of urban neighborhoods. There is some slight evidence, however, that such changes are now starting to favor smog over non-smog areas.

Discussion

Initial urban settlement in Los Angeles and Orange Counties intensifies certain natural hazards that become associated with land conversion to urban uses. In this respect, brush fires, earth slides, and floods may reflect a lack of rapid applications of resource preserving technology and a consequent lack of use of certain urban lands. As settlement densities increase, and as urban land passes through the urban housing cycle, changes in the urban environment lead to the intrusion of air pollution. Air pollution is more concentrated in long settled areas with older housing than in recently settled areas with newer housing and thus represents a residual of urban development. A long history of urban settlement within Los Angeles appears to make a more important contribution to smog than the current state of land use. Air traffic noise, on the other hand, is not significantly related to the pattern of urban settlement in Orange County, but is making inroads on airspace over older neighborhoods in Los Angeles County.

With the exception of initial construction and urban renewal or community redevelopment, the urban housing cycle and the aging of the urban housing stock represents a pattern of physical deterioration that may be associated with a further downgrading of the urban environment. Smog is somewhat characteristic of low rent, urban, and ethnic subareas of the city. Natural hazards, however, are associated with those populations more able to pay for the cost of converting rural land to urban use. The urban housing cycle makes a more important contribution than does smog to variations in the social and demographic characteristics of urban subareas.

Within Los Angeles County, 1950 to 1960 population and dwelling unit increases have favored non-smog instead of smog areas. Nevertheless the proportionate reduction in smog exposure for the total population during this period can largely be accounted for as reflecting population redistribution to newly settled areas at the periphery of the metropolis. In this respect, smog has not been isolated as an important factor in population redistribution away from affected sites. Contrasting urban populations and functions, however, have differential opportunities to escape air pollution. From 1950 to 1960 smog exposure reductions were proportionately greater for non-Negroes than for Negroes, white collar than for blue collar workers, younger than for older populations, single family than for multiple family dwelling units, and owner occupied than for renter occupied units.

Given an expanding metropolitan population and housing stock, and different employment locations and settlement opportunities, contrasting population and housing changes related to smog then take place in different kinds of areas. Smog or other artificial hazards do not clearly result in a shortening of time for the completion of the housing cycle or a more rapid filtering down of areas to new populations or functions. But once an "optimum" utilization of urban land has been reached, a lack of control over artificial hazards could make for differential population changes and a potential lack of use of those portions of the urban scene which are subject to such hazards. There is a need for comparative data from other metropolises regarding artificial and natural hazards of micro-urban environments with respect to their influence on population redistribution.

Footnotes

Chapter IV

[1] Edgar W. Hoover and Raymond Vernon, Anatomy of a Metropolis, (Cambridge, Mass.: Harvard University Press, 1959), Chapter VIII.

[2] Ernest W. Burgess, "The Growth of the City," in Robert E. Park, Ernest W. Burgess, and Roderick D. McKenzie, The City (Chicago: University of Chicago Press, 1925), Chapter II; and "The Natural Area as the Unit for Social Work in the Large City," Proceedings of the National Conference of Social Work (Chicago, 1926).

[3] The general outlines of population change in Los Angeles City have been found to be in agreement with the Hoover-Vernon description. See Beverly Duncan, Georges Sabagh, and Maurice D. Van Arsdol, Jr., "Patterns of City Growth," American Journal of Sociology, LXVII, No. 4 (January, 1962), 418-429. For another use of age of settlement see Leo F. Schnore, "The Socio-Economic Status of Cities and Suburbs," American Sociological Review, XXVII, No. 1 (February, 1963), 76-85.

[4] Walter Firey, Land Use in Central Boston (Cambridge: Harvard University Press, 1947).

[5] See, for example, the studies summarised by James A. Quinn, Human Ecology (New York: Prentice Hall, Inc., 1950.

[6] One exception is Otis Dudley Duncam, "Social Organization and the Ecosystem," Handbook of Modern Sociology, ed. Robert E. L. Faris (Chicago: Rand McNally and Co., 1964), pp. 37-87.

[7] Duncan, Sabagh, and Van Arsdol, loc. cit.

[8] Edgar W. Hoover and Raymond Vernon, Anatomy of a Metropolis (Cambridge, Mass.: Harvard University Press, 1959), Chapter VII.

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[9] Gross acreage for census tracts were constructed from unpublished data from the State of California Division of Highways Metropolitan Region Transportation Study.

[10] For a discussion of the importance of past growth in shaping the configuration of the metropolis, see Beverly Duncan, "Variables in Urban Morphology," Ernest W. Burgess and Ronald J. Bogue, editors, *Contributions to Urban Sociology* (Chicago and London: The University of Chicago Press, 1963), pp. 17-30.

[11] The age of housing index is not synonymous with age of settlement, as age of housing is defined in terms of the recency of construction of contemporary housing and age of settlement is based on a reconstruction of the date at which land passed from rural into urban use. The age of housing stock in a new metropolitan area such as Los Angeles should be highly correlated with age of settlement.

[12] The age of housing index is analagous to the Davis Index used to describe this distribution of communities by size. Use of the Davis Index is described in Kingsley Davis and Ana Casis, "Urbanization in Latin America," *The Milbank Memorial Fund Quarterly*, 24, 1946, pp. 186-207; Kingsley Davis, *The Population of India and Pakistan* (Princeton: Princeton University Press, 1951), p. 129; Jack P. Gibbs and Walter T. Martin, "Urbanization and Natural Resources: A Study in Organizational Ecology," *American Sociological Review*, 23, 1958, pp. 266-277. The basic data for the census tract measures, with the exception of the environmental hazard information, was obtained from the census tract bulletins prepared in conjunction with the Eighteenth Decennial Census, taken as of April 1, 1960. See U.S. Bureau of the Census, *U.S. Censuses of Population and Housing, 1960, Census Tracts*, Final Report PHC (1)-82, Washington, D.C., 1962.

[13] Duncan, "Variables in Urban Morphology," *loc. cit.*

[14] See, James A. Quinn, *loc. cit.*

[15] Duncan, Sabagh and Van Arsdol, *loc. cit.*

[16] See S. L. Wolfbein and A. J. Jaffe, "Demographic Factors in Labor Force Growth," American Sociological Review, II, 392-396, for an example of the mode of analysis here utilized.

[17] For examples of previous use of this form of analysis, see George Myers, "Variations in Urban Population Structure," Demography, I, No. 1, pp. 156-163; and Otis Dudley Duncan, and Raymond P. Cuzzert, "Regional Differentiation and Socio-Economic Change," Papers and Proceedings of the Regional Science Association, IV, 1958, pp. 163-176.

[18] The definitions in this analysis follow those used by Otis Dudley Duncan, Ray P. Cuzzert, and Beverly Duncan, Statistical Geography: Problems of Analyzing Areal Data (Glencoe, Ill.: Free Press, 1961).

[19] The correlation of deviational change incorporates all of six linear intercorrelations between two sets of observations for two points of time. The formula for the correlation of deviational change is expressed as follows:

$$rv_xv_y = \frac{rx_2y_2 - rx_2y_1ry_1y_2 - rx_1y_2rx_1x_2 + rx_1y_1rx_1x_2ry_1y_2}{1 - r^2x_1x_2\ 1 - r^2y_1y_2}$$

where: rv_xv_y = correlation of deviational change, r = a product moment correlational coefficient, x = 1st variate, y = 2nd variate, 1 = 1st time point, 2 = 2nd time point.

CHAPTER V

REALITIES AND PERCEPTIONS OF ENVIRONMENTAL HAZARDS

Introduction

Contemporary hazards of metropolitan environments are activated by technological and organizational mechanisms for modifying urban land. The previous chapter has shown, that, while population redistribution away from Los Angeles sites affected by environmental hazards is currently a function of normal aggregation and expansion, contrasting population categories show differential movement away from hazard areas. It is assumed that the basic relations between components of urban ecological systems operate at metropolitan levels. Within these systems, however, there is room for personal response and choice. Reactions to interhuman experiences also structure the behavior of individuals comprising population aggregates.[1] Thus individual perceptions and shared images of hazards, as well as their recorded nature, become factors to be explained.

This chapter deals with conjunctions of environmental hazard realities and perceptions in Los Angeles and Orange Counties, and influences of images of the urban scene upon perceptions of hazards.[2] Emphasis is first given to how hazard presence, as indicated by monitored levels, influences hazard perceptions. Social-demographic and social-psychological properties differentiating between perceiving and non-perceiving populations are then examined. In conclusion, there is a description of population readiness to perceive hazards, and the way in which this readiness is influenced by living in neighborhoods at different stages of urban development.

Metropolitan areas share similar patterns of social organization and environmental utilization. Nevertheless, population responses to metropolitan experiences reflect images referring to one or more components of an ecological system.[3] Detroit may be viewed as a dynamic complex of automotive technology, Phoenix as a southwestern desert oasis, and Chicago as a great midwestern industrial and commercial center.[4] Los Angeles, on the other hand, has been portrayed as the megalopolis of the future,[5] with a population of transplanted midwesterners,[6] a fragmented political organization,[7] an auto based technology,[8] and an environment dominated by sunshine and smog.[9] Scurrying vehicles and the visual sweep of freeways have here replaced the rumbling commuter trains and steel frame buildings previously symbolizing eastern cities. A recurring Los Angeles image is that of a metropolis in precarious balance with nature.[10] Air pollution is the sign of the Los Angeles environment; other symbols of a perilous habitat have been generated by news media from portrayals of the Portuguese Bend earth slides on the Palos Verdes Penninsula in 1958, the Baldwin Hills dam disaster and flood of 1963, and the Bel Air brush fire of 1962. To the extent that the population of the metropolis constitutes an apperceptive mass, these representations lead to perceptions and imagery of dangerous environmental contingencies impeding normal life.

Although subtly intertwined, realities and perceptions of environmental hazards are not bound together. If hazards are present in neighborhoods, residents are not always aware of them. For example, less than one-third of a 1962 Los Angeles and Orange County area probability sample living in areas contaminated by photochemical air pollution indicated they were aware of a "smog problem" in their vicinity. Monitored air pollution in these neighborhoods was sufficiently severe to be considered unpleasant by the criteria of visibility, plant damage, and eye irritation enumerated in Chapter III. Populations may also perceive hazards in areas where they are not recorded; one-sixth of the respondents in the above sample living in districts with clean air felt that their neighborhoods had smog problems.

Explication of the above differences rests on the nature of perceptual processes, as well as on organizational influences. It has long been noted, that, in addition to individual sensory structures, thresholds, and adaptations; stimulus properties--including size, frequency, intensity, movement, and number--influence and modify perception.[11] While air pollution itself kindles perceptual behavior, other factors--including attention, needs and desires, social influences, and past experiences--contribute to smog perceptions. Particularly important are "symbolic environments" of individuals and population aggregates, which represent intra and inter-psychic organization and interpretations of past events. In this respect "man's response to a symbol is in terms of meanings and values rather than in terms of its physical stimulation of his sense organs."[12] Symbolic environments of individuals and aggregates are thus influenced by interhuman communication, which focuses attention on sources of stimulation, delimits their significance, and helps to identify, facilitate and interpret sensory discriminations.[13]

Given the precondition that individuals designate perceived phenomena, reality-perception discrepancies can be explained partially by meanings and values imputed to that which is observed. Awareness is a first step in perception, whether stimuli represent internal physiological states, or external conditions, such as "seeing and smelling smog." While individuals may react to impinging stimuli, they cannot perceive nor take conscious action in response to them until they are designated or objectified. The designation process is related closely to meanings imputed to stimuli. Furthermore, humans do not perceive a carbon copy of the external world, instead they select some aspects of their sensory fields, and interpret and react to them; perceived reality is "constructed" by each individual.[14]

Categorization of impinging events depends on classes of learned responses that are assigned meanings and supported to the extent that they lead to correct anticipations of future events or satisfactory explanations of past experiences.[15] These expectations concurrently account for perception in a manner similar to a "self-fulfilling prophecy," whereby events come to have real consequences for human life if they are defined as real in their effects.[16] Urbanites may thus be expected to perceive environmental hazards to the degree that their symbolic environments reflect geophysical and biotic conditions. Symbolic environments, however, depend upon a readiness to perceive hazards, access to communication channels describing perils, and the extent to which hazards are defined as relevant to the urban scene. In order to clarify the reality-perception issue, this chapter specifies relations of the perception and presence of monitored hazards. Descriptions of perceiving and non-perceiving urban subpopulations provide clues to the norms that may facilitate hazard perception. Finally, a portrait of different types of urban environments and their hazard perceiving populations shows how urban experiences and hazard perceptions are intertwined.

Collection of Perceptual Data

Data on the perception of environmental hazards were obtained in the summers of 1961 and 1962.[17] An area probability sample of all housing unit residents in the 1960 Los Angeles metropolitan area was constructed which led to interviews with respondents from 300 of the 1403 census tracts in the area. A 90.2 per cent response rate, or

981 interviews were obtained for occupied housing units in 1961. In 1962, 43 housing units were newly vacant, and interviews were completed with 824 residents representing 87.8 per cent of the then occupied units. The 1962 sample, which was the basic data source on perception for this investigation, does not reflect units added to the metropolitan area housing inventory in the one year interval between the interview dates, but it is descriptive of the 1962 population for housing units occupied in 1961.

The samples was designed as representative of the adult housing unit population of Los Angeles as well as of the metropolitan housing units. That is, while information on census type variables could be obtained from any adult member of the household, attitudinal and experential information could be reliably obtained only from the individuals concerned. A random selection device was utilized within housing units in order to include respondents from which both census type, as well as attitudinal and perceptual information, were obtained.[18]

Reality - Perception Relationships and Urban Social Structure

In this analysis of the presence and the perception of environmental hazards, respondents were asked whether or not given hazards constituted "serious" or "not serious" problems in their neighborhoods, and in their counties of residence. Responses were used as dependent variables to delineate the relationship of perceptions to the measured presence or absence of hazards.

The independent variable influencing perception was here considered to be the presence or absence of the hazard; as well as a series of respondent characteristics including social-economic status, family structure, dwelling unit type, race, age, and sex. These characteristics were selected since they have been used in previous studies as major components of urban population composition and behavior.[19] Variables referring to the components were defined in the following way: socio-economic status of the head of the household was measured by the Duncan-Riess Index;[20] family structure was described with respect to membership in a "complete" or "incomplete family" where incomplete family referred to single individuals, broken, miscellaneous and doubled-up unrelated family types;[21] dwelling unit type was defined by residence in a single or multiple family unit; race was dichotomized into whites and non-whites; and age, determined for the head of the household, was dichotomized at the age of 35 years in order to reflect the presence or absence of "young children" expected on the basis of the family life cycle.[22]

In addition to the preceding population composition components, there was a desire to determine how urban experiences influence environmental perception. Measures of the respondents' neighborhood satisfaction and of their integration into the urban normative structure were used to implement this concern. Neighborhood satisfaction was determined by the individuals' responses to questions concerning their satisfaction or dissatisfaction with their neighborhoods of residence,[22] and integration into the normative structure was measured by use of Srole's anomie scale.[23]

The pattern of hazard reality and perception.--It is emphasized that the areal and individual measures of environmental hazards used in this research are not comparable. "Reality" is based on physical measures of the urban environment as defined in Chapter III, while perception is defined by individual responses concerning whether or not hazards were perceived. Measures of association between reality and perception, however, can be used to indicate their relationships. Table 12 describes the percentage of the Los Angeles metropolitan area sample living

TABLE 12

DISTRIBUTION OF ENVIRONMENTAL HAZARDS AND RESPONDENTS PERCEPTION OF HAZARDS LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA SAMPLE: 1962[1]

Hazard	Total Respondents	Sample in Hazard Area		Hazard Perceivers		Hazard Present Hazard Perceivers		Hazard Absent Hazard Perceivers	
	No.	No.	%[2]	No.	%[2]	No.	%[3]	No.	%[4]
Smog	800	416	52.0	225	28.1	162	38.9	63	16.4
Air Traffic Noise	792	156	19.7	96	12.1	42	26.9	54	8.5
Brush Fire	795	30	3.8	49	6.2	9	30.0	40	5.2
Earth Slide	787	43	5.5	30	3.8	8	18.6	22	2.8
Flood	780	125	16.0	33	4.2	8	6.4	25	3.8

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[1] Percentages do not add to 100.

[2] Percentages based on total respondents.

[3] Percentages based on sample in hazard area.

[4] Percentages based on sample not in hazard area.

in neighborhoods characterized by the presence of environmental hazards and perceptions of hazards in neighborhoods of residence by hazard conditions. With the exception of brush fires, a smaller proportion of the sample perceived the hazards than lived in neighborhoods with the hazards present. Smog was the most frequently perceived hazard in residence districts; a higher percentage of the Los Angeles population was exposed to smog than to any other hazard; and smog was most crucial for hazard perception, whether or not respondents lived in hazard areas. Chi-square tests of independence, as reported in Table 13, showed that, with the exception of flood, there was an association between the presence and perception of the hazards at the .01 level of significance. In this respect, the smog reality-perception pattern is similar to that for other hazards.

Procedures for analyzing reality-perception relationships.--Given the demonstrated reality-perception relationships between all hazards except flood, it was ascertained whether these associations could be accounted for by individual placement in the urban social structure. An attempt was made to account for associations of reality and perception in terms of a series of independent variables utilized as controls. A simple analysis of interaction

TABLE 13

ENVIRONMENTAL HAZARDS: REALITY-PERCEPTION RELATIONSHIPS, CONTROLLING FOR COUNTY PERCEPTION
LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA, 1962

Hazard X Neighborhood Perception X County Perception	X^2	ϕ	Q	Significance	Interaction
Smog X Neighborhood Perception	49.16	.25	.53	.001	
Smog X Neighborhood Perception X Perceived in County	50.00	.29	.56	.001	Yes
Smog X Neighborhood Perception X Not Perceived in County	1.67	.10	.59	No	
Noise X Neighborhood Perception	39.98	.60	.22	.001	
Noise X Neighborhood Perception X Perceived in County	18.75	.15	.59	.001	Yes
Noise X Neighborhood Perception X Not Perceived in County	.55	.08	.53	No	
Fire X Neighborhood Perception	21.43	.16	.77	.001	
Fire X Neighborhood Perception X Perceived in County	35.29	.27	.79	.001	Yes
Fire X Neighborhood Perception X Not Perceived in County	.09	.19	.66	No, Z=1.90	
Slide X Neighborhood Perception	18.71	.15	.76	.001	
Slide X Neighborhood Perception X Perceived in County	11.62	.18	.74	.001	Yes
Slide X Neighborhood Perception X Not Perceived in County	5.10	.82	.11	No, Z=3.0	
Flood X Neighborhood Perception	0.91	.22	.02	No	No
Flood X Neighborhood Perception X Perceived in County	1.74	.02	.26	No	
Flood X Neighborhood Perception X Not Perceived in County	0.47	.24	.03	No	

Z test used due to small cell frequencies.

among categorical variables was used to evaluate the effects of the control variables upon the reality-perception relationships.[24] Hazard data were dichotomized according to recorded presence or absence of hazards in a census tract, and perceptions were dichotomized according to whether the hazards were perceived as "serious" or "not serious." In addition, data used for the control variables--sex, age, socio-economic status, family type, dwelling unit type, race, neighborhood satisfaction and anomie--were dichotomized.[25] The chi-square test of independence, at the .01 level of significance, was used to establish the over-all relationship between the perception of a given hazard and its recorded presence. The degree of association between the reality of the hazard and its perception was specified by a Q and a Phi coefficient.[26] The Z test for differences between proportions was used when the chi-square expected or observed cell frequencies were less than five or ten, respectively.[27]

After reality-perception relationships were determined, control variables were introduced to determine if they changed the original association. For each comparison, two fourfold contingency tables were constructed. It was then established if the original reality-perception relationship changed when the control variable was introduced. If the chi-square or Z test differed between the subclasses--that is, was significant for one of the contingency tables and not for the other--the result was interpreted as indicating that there was interaction between the control variable and the original reality-perception association. If interaction was found, the control variable was considered to influence the reality-perception relationship. Tests for brush fire and earth slides were inconclusive due to the small portions of the sample residing in areas affected by these hazards.

Effects of county hazard perception.--Table 13, which summarizes reality-perception patterns for the five hazards controlling for the county hazard perception effect, illustrates the mode of analysis. For smog, a statistically significant relationship was found between reality and perception. The reality-perception relationship was significant for county smog perceivers but was not significant for respondents not perceiving smog in the county. Differences in significance between county smog perceivers and non-perceivers was interpreted as indicating that county smog perception influenced the reality-perception relationship for smog with county perceivers being more likely to perceive neighborhood smog than county non-perceivers. To summarize Table 13, interaction was found for smog, noise, and slide, but not for flood, and results were indeterminate for fire. The perception of smog, noise, and slide in the county was then taken as influencing the reality-perception relationships. Table 14 further indicates that respondents generalized between the perception of the hazard in the neighborhood and the county since for smog and each other hazard a significant chi-square was obtained. The treatment of county hazard perception as an independent variable was used for statistical purposes only and does not establish the priority of county perception as a determining variable for neighborhood perception.

Effects of demographic and social characteristics.--Relationships between hazard reality and perception, controlling for population characteristics, are summarized in Table 15. The sex of respondents did not influence reality-perception relationships. Age influenced these relationships only in the case of slides, where subjects over 35 years of age were more likely to perceive the hazard than were younger respondents. Socio-economic status influenced the reality-perception relationship for slide, with high status

TABLE 14

RELATIONSHIP BETWEEN NEIGHBORHOOD AND COUNTY HAZARD PERCEPTION LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA: 1962

Hazard	X^2 (1 df.)	Q	ϕ	Significance
Smog	71.42	.898	.300	,001
Noise	165.82	.904	.466	.001
Brush Fire	19.75	.804	.160	.001
Earth Slide	24.06	.835	.179	.001
Flood	42.69	.875	.237	.001

TABLE 15

REALITY-PERCEPTION RELATIONSHIPS CONTROLLING FOR SEX, AGE, SOCIO-ECONOMIC STATUS, FAMILY TYPE, DWELLING UNIT TYPE, RACE, NEIGHBORHOOD SATISFACTION AND ANOMIE LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA: 1962[1]

Control Variable	Hazard	Inter-action	Direction
Sex	Smog X Neighborhood Perception	No	
	Air Traffic Noise X Perception	No	
	Brush Fire X Neighborhood Perception	No	
	Earth slide X Neighborhood Perception	No	
	Flood plus Neighborhood Perception	No	
Age	Smog X Neighborhood Perception	No	
	Air Traffic X Neighborhood Perception	No	
	Brush Fire X Neighborhood Perception	No	
	Earth slide X Neighborhood Perception	Yes	Subjects 35 plus perceive hazard
	Flood X Neighborhood Perception	No	
Socio-economic Status	Smog X Neighborhood Perception	No	
	Air Traffic X Neighborhood Perception	No	
	Brush Fire X Neighborhood Perception	No	
	Earth slide X Neighborhood Perception	Yes	High SES perceive hazard
	Flood X Neighborhood Perception	No	
Family Type	Smog X Neighborhood Perception	No	
	Air Traffic X Neighborhood Perception	No	
	Brush Fire X Neighborhood Perception	Yes	Broken family perceive hazard
	Earth slide X Neighborhood Perception	Yes	Broken family perceive hazard
	Flood X Neighborhood Perception	No	

TABLE 15--Continued

Control Variable	Hazard	Interaction	Direction
Dwelling Unit Type	Smog X Neighborhood Perception	No	
	Air Traffic X Neighborhood Perception	No	
	Brush Fire X Neighborhood Perception	No	
	Earth slide X Neighborhood Perception	No	
	Flood X Neighborhood Perception	No	
Race	Smog X Neighborhood Perception	Yes	Whites perceive hazard
	Air Traffic X Neighborhood Perception	Yes	Whites perceive hazard
	Brush Fire X Neighborhood Perception	No	
	Earth slide X Neighborhood Perception	No	
	Flood X Neighborhood Perception	No	
Neighborhood Satisfaction	Smog X Neighborhood Perception	Yes	Satisfied perceive hazard
	Air Traffic X Neighborhood Perception	Yes	Satisfied perceive hazard
	Brush Fire X Neighborhood Perception	Yes	Satisfied perceive hazard
	Earth slide X Neighborhood Perception	Yes	Satisfied perceive hazard
	Flood X Neighborhood Perception	No	
Anomie	Smog X Neighborhood Perception	No	
	Air Traffic X Neighborhood Perception	No	
	Brush Fire X Neighborhood Perception	Yes	Eunomic perceive hazard
	Earth slide X Neighborhood Perception	No	
	Flood X Neighborhood Perception	No	

Results on brush fire and earth slide hazards are only tentative due to small proportion of population living in these areas.

respondents being more likely to perceive the hazards than low status respondents. A similar finding for fire and slide was found with respect to family type, with hazards being perceived more often by respondents from broken than from complete families. This increased awareness could mean that members of incomplete families are more vulnerable to economic hazards than people living in complete families. Dwelling unit type exerted no influence on the reality-perception relationship. Race influenced reality-perception relationships for smog and air traffic noise, with whites being more likely to perceive the hazards than non-whites.

The above findings suggest that the social structure, defined in terms of the above measures, did not consistently differentiate the extent to which there was an association between hazard reality and perception. The finding with respect to race and perception was not necessarily in disagreement with the similarity of the distribution of smog and ethnic populations. It may be that, while non-whites are concentrated in smog areas, the intrusion of social hazards in such areas and the preoccupation of non-white populations with other issues may have obscured their environmental hazard perception. On the other hand, the specific problems of another segment of the population, such as people living in broken homes, may account for their perception of certain economic hazards. Personal problems or interests may have a differential effect on hazard perception.

Effects of attitudinal factors.--Table 15 also presents reality-perception relationships as influenced by attitudinal characteristics of respondents. There was an interaction effect for reality and perception of smog, airplane noise, brush fires, and slides, while controlling for neighborhood satisfaction. For each of these relationships, satisfied respondents were more likely to perceive the hazards than dissatisfied respondents. Anomic or eunomic class placement only influenced the relationships for brush fires, where the small number of respondents precluded definitive results. Thus, while integration into the social structure, as measured by the anomie instrument, did not alter the reality-perception relationships, reality-perception was affected by neighborhood satisfaction. In general, smog operated much like the other hazards in influencing the relations of reality and perception for both social psychological and social structure variables.

Discussion.--There is a direct relationship between the presence of a hazard and its perception, although there is a good deal of mis-perception to be explained. Smog is the most common of the observed environmental hazards in Los Angeles, and when compared with the other hazards, is the most important for hazard perception. No consistent findings are observed for the influence of social structure variables upon reality-perception relationships. It may be that environmental hazards of the type described are part of the accepted difficulties of life for some urban subpopulations. Non-whites, for example, who tend to be more concentrated in health hazard areas, do not perceive smog and air traffic noise to the same extent as the white population. Moreover, being bound to middle class norms, as indicated by responses to an anomie scale, does not influence relationships of reality and perception, yet anomic individuals are found more frequently in smog areas. These findings suggest that measures of social position do not consistently influence reality-perception relationships when applied to individuals.

On the other hand, respondents' neighborhood evaluations in terms of expressed over-all satisfaction do affect the perception of reality. It may well be that these hazards are perceived in the context of assumptions that urban populations make about the immediate spatial context of their lives. In this respect, there may be selective perception of environmental hazards incorporated into a pre-existing experiential organization. Such an organization can be independent of socio-economic characteristics and integration of respondents into the life of the metropolis. The experiential organization instead may reflect common perspectives of persons sharing similar communication channels. The channels need not have a neighborhood foundation in a complex and segmented metropolitan area, where other bases of identification pertaining to differential contact and communication may predominate.

While smog is more often present and perceived in the metropolitan area, it does not evoke unique population perceptions. Reactions to smog appear to be similar to other urban annoyances. In Los Angeles, environmental hazards appear to be systematically related to the characteristics of urban subarea populations, when measurements are made on a census tract basis. The reactions of metropolitan population to hazards, however, are not uniformly influenced by the selected measures of their individual placement in the social structure.

These findings show, that, it is not sufficient to know that environmental hazards exist in an area in order to predict that they will be recognized or perceived; one must understand the symbolic environment of urban populations in order to make such predictions. It was assumed that persons living in highly publicized environmental hazard areas expect hazards to be present, and therefore are more likely to perceive them than persons living in non-hazard areas who do not expect hazards to be present, or who lack experience in their recognition. The population living in Los Angeles County is undoubtedly aware of smog since the news media's daily weather reports include announcements concerning expected levels of smog for the area. The assumption that smog expectation would be associated with perception was partially confirmed by comparing smog perception of Los Angeles and Orange County respondents while controlling for the differences in neighborhood smog levels. Since Orange County has not been as clearly identified with smog as Los Angeles County, it was assumed that a smaller proportion of Orange County residents would perceive smog when the real environmental conditions were the same in the two areas. No differences in smog perception were found between respondents living in non-smog areas of

Los Angeles and Orange Counties, but a significant difference was found in the perception of respondents living in smog areas in the two counties. The Los Angeles residents perceived smog more frequently than the Orange County residents when smog was equally present in both places.

Attitudes Towards Hazard Perception

To focus more attention on individual responses or lack of responses to hazards, and to simultaneously examine the hiatus between individual responses and neighborhood characteristics, two additional questions were examined. First was whether populations develop a generalized readiness to perceive hazards; second was how this readiness is related to placement in society and experiences in different kinds of metropolitan neighborhoods. These analyses control for both individual and neighborhood variations affecting hazard perceptions.

Attitudes for perceiving hazards.--Perceptions of segments of human experience appear to depend on more generalized understandings.[28] In order to test this assumption with reference to environmental hazards it was first necessary to determine that experience is generalized in terms of a definite perceptual structure, and that perceptual structure in turn generates specific perceptions. This assumption was tested by relating neighborhood hazard perception to hazard perception for the county of residence.

Hazard perceptions in Los Angeles and Orange Counties have a universe of common content. An application of the Cornell technique[29] of scale analysis indicated that comprehensions of smog, brush fires, earth slides, and floods in the county constitute a hazard perception scale from which the perceptions of individual hazards could be reproduced from the total hazard perception scores of the respondents.[30] The derived scale, which consisted of four dichotomous items,[31] and eight response categories, had a coefficient of reproducibility of 92 per cent; extreme modal categories contained 85 per cent of the responses--with the other six categories containing between 25 and 75 per cent of the responses; the minimum marginal reproducibility was 65 per cent; and no items had more error than non-error.[32] The intrapersonal organization of the perception of environmental hazards in the metropolitan area, as here defined, included and reproduced the perception of smog.

Having determined that hazard perceptions have a universe of common content the influence of environmental hazard awareness upon smog perception in the neighborhood was examined. There was no difference in scale scores between respondents who perceived smog and those who did not, but when "accurate perceivers" were compared with "inaccurate perceivers," a significant difference in scale scores emerged. Accurate perceivers were defined as those persons who reported smog as a problem in their neighborhoods (census tracts) when it was recorded by air pollution control districts, and did not respond to it as a problem when it was not recorded. Inaccurate perceivers were persons for whom there was no correlation between perception and the recorded presence or absence of air pollution. Data not shown indicate lower hazard perception scores for inaccurate than for accurate perceivers; that is inaccurate perceivers were less generally aware of environmental hazards. Strength of feeling about hazards in the county of residence is associated with accuracy of air pollution perception in the neighborhood or residence.

Since differences in strength of perception of hazards were found, attention was focused on a description of respondents with high and low hazard perceptiveness scale scores. Examining respondants with the highest and lowest scale scores, relationships were found between hazard perceptiveness and certain demographic and social characteristics, as shown in Table 16. Measures employed in this analysis were similar to those previously used to examine the relationship of population components and attitudinal variables with perception. Age was classified by the age of the head of the household and dichotomized between those over 35 and under 35 years of age in order to coincide with the presence or absence of "young" children. Socio-economic status was based on the head of the household's position on the Duncan-Reiss index.[33] Family type was described with reference to current membership in a "complete" or "incomplete" family where "complete" specified married couples living together with their children and/or immediate relatives.[34] Dwelling unit type referred to living in single or multiple residential units. Owners were compared to those who rented their homes. Geographical background of the head of the household was determined by the state in which the head of the household was brought up dividing "native" Californians and others. Ethnicity was defined as whites and non-whites. County of residence was used to compare respondents living in Los Angeles County with those residing in Orange County. Education was dichotomized between respondents who had completed high school and those who had not. The two attitudinal variables were based on

TABLE 16

RELATIONSHIP BETWEEN GUTTMAN SCALE OF ENVIRONMENTAL HAZARDS AND SOCIAL-STRUCTURAL VARIABLES LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA SAMPLE: 1962

Variable	X^2 (1 df.)	Significance
Sex	7.60	.01
Age	2.12	No
Socio-economic Status	.01	No
Family Type	.57	No
Dwelling Unit Type	.13	No
Own-Rent	.32	No
Urban-Rural Previous Residence	8.44	.01
State Where Head of Household Brought Up	.21	No
Ethnic Group	.54	No
Neighborhood Satisfaction	.43	No
Anomie	1.08	No
Education	12.72	.001
County of Residence L.A. / Orange	70.67	.001

responses to a question concerning respondent satisfaction with neighborhood of residence,[35] and responses to Srole's anomie scale.[36]

Neither age, ethnic groupings socio-economic status nor type of dwelling unit were associated with hazard perceptiveness. Nor did it matter if respondents owned or rented their homes, were anomic or eunomic, or were satisfied or dissatisfied with their neighborhoods of residence. Nevertheless, those who perceived hazards more readily, or who had a generalized awareness of hazards, were more frequently male than female, had at least a high school education, had experiences in urban rather than rural environments, and resided in areas where they may have expected smog to exist, such as Los Angeles as contrasted with Orange County. Remaining differences relate to factors of communication impinging on the respondent. By dint of greater exposure to urban life, males are in a position to have greater environmental awareness than females. Those who are more highly educated are also more aware of information offered by the mass media on environmental hazards. Similarly, people with an urban background will have been more exposed to information dealing with the problems of an urban environment than those with a rural background.

The effect of education on other social characteristics and perceptiveness is illustrated in Table 17. With education held constant, it is apparent that there are few changes in the relationship of social characteristics and hazard perceptiveness. There was an interaction between age, perceptiveness and the attainment of at least a high-school education. Those high-school graduates, who were under 35 years of age, had a stronger generalized attitude toward environmental hazards than those who were older and/or who had not completed high school. The same was true of the other differences. Males with at least a high school education, and all those who had a high school education and who had lived in urban areas were more perceptive in regard to environmental hazards than their opposites.

Individual and areal variables.--In an attempt to delineate the effects of both individual and areal variations to hazard perceptiveness an analysis similar to the previous ones was undertaken. Table 18 shows the relationship of social characteristics to perceptiveness when the urban housing cycle, as measured by date of settlement, was used as a control variable. The character of the past history of urban neighborhoods influenced the relationships

TABLE 17

SOCIAL-STRUCTURAL VARIABLE REALITY-PERCEPTION RELATIONSHIPS CONTROLLING FOR EDUCATION LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA: 1962

Variable	Interaction	Direction
Age X Perception	Yes	High education below 35 perceive hazard
Sex X Perception	Yes	High education males perceive hazard
Socio-economic Status X Perception	No	
Ethnic Group X Perception	No	
Dwelling Unit Type X Perception	No	
Family Structure X Perception	No	
One Year Intent to Move X Perception	No	
Five Year Plan to Move X Perception	No	
Neighborhood Satisfaction X Perception	No	
Anomie X Perception	No	
Own-Rent X Perception	No	
Urban-Rural Previous Residence X Perception	Yes	High education urban perceive hazard
State Head Brought Up X Perception	No	
Accurate - Inaccurate Perception X Perception	No	
County of Residence X Perception	No	

TABLE 18

SOCIAL-STRUCTURAL VARIABLES AND PERCEPTION RELATIONSHIPS CONTROLLING FOR DATE OF SETTLEMENT LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA

Variables	Interaction	Direction
Age X Perception	No	
Sex X Perception	Yes	Old area males perceive hazard
Socio-economic Status X Perception	No	
Education X Perception	No	
Ethnic Group X Perception	No	
Dwelling Unit Type X Perception	No	
Family Structure X Perception	No	
One Year Intent to Move X Perception	No	
Five Year Plan to Move X Perception	No	
Neighborhood Satisfaction X Perception	No	
Anomie X Perception	No	
Own-Rent X Perception	No	
Urban-Rural Previous Residence X Perception	Yes	New area, urban perceive hazard
State Head Brought Up X Perception	No	
Accurate-Inaccurate Perception X Perception	No	
County of Residence X Perception	No	

of sex and urban-rural background with perceptiveness, and the urban-rural background of the respondent and perceptiveness.

Males living in older areas--those settled prior to 1950--were more perceptive than males in areas more recently settled. It should be remembered that the relationship between date of settlement and presence of smog has already been demonstrated. Also, respondents with an urban background who lived in newly settled neighborhoods were more perceptive than those living in older areas. An urban background, thus leads to an awareness of environmental problems of urban life. When populations move to newer neighborhoods they may well be more concerned with avoiding further encroachment of environmental hazards which have been taken for granted in the older areas of the city.

Discussion

Metropolitan and neighborhood imagery generated by technological modifications of environmental sites have important meanings for the population of Los Angeles and Orange Counties. While urban growth and expansion processes explain redistribution of population from sites affected by environmental hazards, perception is relevant in hazard response. Belief and reality comprise the warp and woof of environmental hazards. Monitored levels and perceptions of hazards, while associated, do not stand in a one-to-one relationship, and the degree of their covariation is apparently a function of the communications channels of urban subpopulations, their symbolic environments, and sophistication in reacting to environmental stimuli and, to a lesser degree, their position in the urban social structure. Positive relations were found between the physical presence of hazards in neighborhoods and their perception. Excluding brush fires, a smaller portion of the Los Angeles and Orange County populations perceive hazards than live in hazard neighborhoods. The most frequently perceived hazard in residence areas was air pollution, which was also the most crucial hazard for perception, whether residents lived in hazard areas or not. These relations, however, do not hold for all population segments exposed or not exposed to hazards. Perception of air pollution is positively related to being Caucasian, and to exhibiting satisfaction with neighborhood of residence.

The differential symbolic environments of urban peoples explain why some metropolitan residents perceive the reality of air pollution, while others do not.

Comparisons of residents of areas with highly publicized hazards and those with hazards less publicized, suggest that expectations influence hazard perceptions. Furthermore, the degree of perception of specific hazards depends upon living in more urban segments of the metropolis, as well as on a more generalized strength of feeling about a series of hazards, which also makes for more accurate hazard perception. Populations with a high degree of hazard orientation tend to be male, have previous residential experiences in urban environments such as Los Angeles, and expectations concerning the vulnerability of their neighborhoods to the hazards of urban life. It may be that those persons who are most directly in line with the media of communication in the metropolis are the ones for whom there is a direct perceived confrontation with the urban environment. Hazards are likely seen in terms of assumption that urban populations make about the immediate spatial contexts of their lives. In this respect, the selective perception of environmental hazards can be incorporated into a pre-existing imagery, which is related to urban experience and training.

Imagery of environmental hazards has important implications for hazard description and the control of the urban environment. In large metropolitan areas the location of hazard monitoring devices depends, in part, on perceptions by populations that hazards exist in their vicinity, and make reports to hazard abatement and control agencies. Relations of the physical and social aspects of a metropolitan ecosystem then come full circle. The subsequent recorded reality of hazards depends upon population perceptions, which thus indirectly influences "objective" reports of the relations of hazard reality to other aspects of metropolitan ecological systems. Chapter V examines the relations of environmental hazards to public response, and the implications of hazard response for programs of abatement and control.

Footnotes

Chapter V

[1] See, for example, the classic statement by Louis Wirth, "Urbanism as a Way of Life," *American Journal of Sociology,* XLIV (July, 1938), pp. 1-24.

[2] Recent studies of urban imagery include those by Scott Greer, The *Emerging City* (New York: The Free Press, 1962); Jane Jacobs, *The Death and Life of Great American Cities* (New York: Random House, Inc., 1961); and, Anslem Strauss, *Images of the American City* (New York: Glencoe, Illinois: The Free Press, 1961). Relatively little attention, however, has been given to how such imagery influence population perceptions of urban environments.

[3] See: Strauss, *ibid.*, pp. 1-51 for a description of the evolution of such images.

[4] *Ibid.*, p. 33, illustration following p. 50.

[5] Arthur Grey, Jr., "Los Angeles, Urban Prototype," *Land Economics*, Vol. XXXV, No. 3, pp. 232-42.

[6] Carey McWilliams, *Southern California Country: An Island on the Land* (New York: Duell, Sloan, and Pearce, 1946), pp. 138-64.

[7] Winston W. Crouch and Beatrice Dinnerman, *Southern California Metropolis; A Study in Development of Government for a Metropolitan Area* (Berkeley and Los Angeles: University of California Press, 1962).

[8] Norm Daguerre, in "LARTS: Information Bank for Community Planners," Part One, *Westways,* (April, 1965), pp. 28-30; Part Two, *Westways* (May, 1965), pp. 31-33; Part Three, *Westways* (July, 1965), pp. 6-8, provides an example of the perceived importance of the automobile and the freeway in shaping the social and economic life of the Los Angeles megalopolis. Reactions to freeway commuting in Southern California are not always unfavorable. The Automobile Club of Southern California, which publishes *Westways* magazine, comprises a powerful pressure group for

the automobile and the freeway. Edward C. McDonagh, of the University of Southern California, was quoted in Time, May 10, 1963, p. 24, as stating that the freeway and the automobile provide a new mode of adjustment, when he indicated that "the car has become a secular sanctuary for the individual, his shrine to the self, his mobile Walden pond."

[9] Cynthia Lindsay, The Natives Are Restless (Philadelphia and New York: J. B. Lippincott Co.), pp. 16-17.

[10] McWilliams, op. cit., in a volume written before the onslaught of air pollution in Los Angeles, gives the following description of a Southern California earthquake from a prophetic novel about Los Angeles by Myron Brinig: . . . "Los Angeles tobogganed with almost one continuous movement into the water, the shoreline going first, followed by the inland communities . . . the small pink, and white, blue and orange houses of the shore were blown like colored sands into the tempest. All of California, from the Siskiyous to Mexico, from the eastern border to the coast, started sliding swiftly, relentlessly into the Pacific Ocean." McWilliams also develops images of water shortages in Los Angeles associated with the obtaining of water from the Owens Valley of inland California; and Lindsay, op. cit., pp. 36-40, describes oil field subsidence, earth slides, flood, sonic booms, and the dangers of freeway travel.

[11] Donald O. Hebb, The Organization of Behavior (New York: Wiley, 1949).

[12] Arnold M. Rose, "A Systematic Summary of Symbolic Interaction Theory," in Arnold M. Rose, editor, Human Behavior and Social Processes (Boston: Houghton-Mifflin Co., 1962), p. 5.

[13] See: Tamotsu Shibutani, Society and Personality (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1961), pp. 108-109, for a discussion of the influence of symbolic environments on perception and meaning.

[14] Ibid., pp. 97-108.

[15] Jerome S. Bruner, "Social Psychology and Perception," in Elanor Maccoby, Theodore Newcomb, and Eugene Hartley, editors, Readings in Social Psychology (New York: Holt, Rinehart and Winston, Inc., 1958), pp. 85-94.

[16] See: Robert K. Merton, *Social Theory and Social Structure* (Glencoe, Illinois: The Free Press), pp. 179-95.

[17] The study design involved the selection of a probability sample of approximately 1,250 housing units allocated in the following way: one housing unit per block, two blocks per enumeration district for each of the anticipated 300 census tracts in the sample. Census tracts, enumeration districts, and blocks were all selected with probabilities proportional to size. Features of this design included geographic stratification of census tracts, estimation of block size within samples enumeration districts, pre-listing of sampled blocks, and compensations for pre-listing errors. Lack of 1960 Census data concerning block size necessitated the use of enumeration districts for which field information was secured on the number of housing units.

[18] Leslie Kish, "A Procedure for Objective Respondent Selection within the Household," *Journal of the American Statistical Association*, XIV (1949), pp. 380-87.

[19] See: Otis Dudley Duncan and Albert J. Reiss, *Social Characteristics of Urban and Rural Communities: 1950* (New York: John Wiley and Sons, 1957); and Eshref Shevky and Wendell Bell, *Social Area Analysis: Theory, Illustrative Application and Computational Procedures*, Stanford Sociological Series No. 1 (Stanford: Stanford University Press, 1955), for illustrations of the use of such variables in describing urban populations.

[20] Albert J. Reiss with the collaboration of Otis Dudley Duncan, Paul K. Hatt, and C. C. North, *Occupations and Social Status* (New York: The Free Press, 1961).

[21] Family type was delimited as follows: "complete family" included full family, family extended downward, extended upward, extended horizontal and extended related family (mixed direction); and "incomplete family" including individual, incomplete, broken, single person, miscellaneous, and doubled up-unrelated. These types were based on those used by Peter Rossi, *Why Families Move: A Study in the Social-Psychology of Urban Residential Mobility*, (New York: The Free Press, 1955). A complete description of the family types used in this and the Rossi study is available from the Roper Public Opinion Center, Williamstown, Mass.

[22] Persons classified as satisfied with their neighborhoods responded "satisfied completely," or "satisfied somewhat" to the question, "Taking all things into consideration, how do you feel about this neighborhood? To what extent are you satisfied or dissatisfied with this neighborhood?" Dissatisfied respondents were those specifying "dissatisfied somewhat" or "dissatisfied completely."

[23] Leo F. Srole, "Social Integration and Certain Corollaries: An Exploratory Study," *American Sociological Review*, XXI (1956), pp. 709-16; also Wendell Bell, "Anomie, Social Isolation, and the Class Structure," *Sociometry*, XX (1957), pp. 105-16. The anomie types were defined in terms of "anomic" and "eunomic" latent classes as obtained from the five item anomie scale. Fifty-five per cent of the 1961 sample was specified as eunomic and 45 per cent was given anomic class placement. The classes were constructed for the data reported in this report by Curtis R. Miller and Edgar W. Butler, "Anomie and Eunomie: A Re-Evaluation of Srole's Anomie Scale," *American Sociological Review*, XXXI (June, 1966), No. 3, pp. 400-406.

[24] S. T. Mayo, "Interactions among Categorical Variables," *Educational and Psychological Measurement*, XXI, pp. 839-58.

[25] Socio-economic index values were dichotomized at the median value of the sample. Of the sample respondents, 74.2 per cent resided in single units, 53.8 per cent were members of complete families, and 90.4 per cent were white.

[26] Morris Zelditch, Jr., *A Basic Course in Sociological Statistics* (New York: Henry Holt, 1959), pp. 169-71. Values of Phi and Q differ due to differences in the definitions of these statistics and the less restrictive conditions for complete association for Q than Phi. Q values reported in this research were greater than Phi in all instances.

[27] J. P. Guilford, *Fundamental Statistics in Psychology and Education* (New York: McGraw-Hill, 1956), pp. 221-222.

[28] See Shibutani, *op. cit.*, pp. 127-28.

[29] See Allen L. Edwards, *Techniques of Attitude Scale Construction* (New York: Appleton-Century-Crofts, Inc., 1957), pp. 172-200.

[30] Responses to airplane noise did not fit into the scale.

[31] The environmental hazard perception scale was based on the following questions: "I would now like to ask you a few questions about problems that face (Los Angeles) (Orange) county. We would like to know what you think about these problems, whether they are serious or not serious. Let's take (air pollution or smog, brush fires, floods, and earth slides). Do you think they are a serious problem or not a serious problem in (Los Angeles) (Orange) County?" "Very serious" and "serious" responses were scored as a perception of a problem, and "not serious" or no response was scored as lack of perception of a problem. Percentages of responses scored as problems were as follows: (1) smog, 74 per cent; (2) brush fires, 56 per cent; (3) floods, 31 per cent; and (4) earth slides, 45 per cent.

[32] Examples of work where these criteria, in addition to the normal reproducibility criterion, have been applied in previous research, include Edgar W. Butler, Georges Sabagh, and Maurice D. Van Arsdol, Jr., "Demographic and Social Psychological Factors in Residential Mobility," *Sociology and Social Research*, XLVIII (January, 1964); and James Mau, Richard J. Hill, and Wendell Bell, "Scale Analysis of Status Perception and Status Attitudes in Jamaica and in the United States," *Pacific Sociological Review*, IV (1961), pp. 33-40.

[33] See footnote 20.

[34] See footnote 21.

[35] See footnote 22.

[36] See footnote 23.

CHAPTER VI

ENVIRONMENTAL HAZARDS AND INDIVIDUAL ACTION

Introduction

Natural environmental hazards have always impinged on human habitats. The history of the artificial hazard of air pollution began in the early Neolithic age. Oedipus has been portrayed as suffering from the furnace fumes of Thebes, and, in 1273 "the use of coal was prohibited in London as being prejudicial to 'health.'"[1] Newcastle "sea-coole smoake" stimulated John Evelyn's unheeded Fumifugium warning to Charles II in 1661.[2] Smoke abatement acts covering the London metropolitan area were first passed in 1853;[3] more modern efforts to control British air pollution stem from the founding of the National Smoke Abatement Institution (a precursor of the National Society for Clean Air) in 1898 or 1899.[4]

Air pollution control programs have a more recent history in the United States, where there was little widespread concern with impure air until after World War II. Here the State of California[5] and the County of Los Angeles[6] have developed extensive programs for air pollution control which have become models for subsequent action at all governmental levels. Since the establishment of the Los Angeles County Air Pollution Control District in 1947, industrial sources of impure air within the county have been largely controlled, and motor vehicles now appear to be the major contributors of air pollutants.[7] Nevertheless, metropolitan population pressures, as described in Chapter III, are a factor leading to smog exposure for increasing numbers of Angelenos. Given existing modes of air pollution control in the County of Los Angeles, and the widening scope of air hazards there is a need to assess whether air pollution perception is effectively related to programs for smog abatement by hazard perceiving metropolitan residents.

Americans have yet to resolve conflicts between private activity contributing to impure air, and private and public spending necessary for the major modifications of the urban environment,[8] which will control air hazards. The extent to which smog abatement programs are implemented depends on relations of hazard perception to population action. The previous chapter has shown that urban populations perceive hazards in contexts reflecting environmental imagery. Hazard perception, however, is not necessarily translated into behavior leading to environmental modifications. This chapter examines the relations of the perception of hazards, including smog, to individual actions of complaints and moving behavior. The first topic is the salience of hazards for overt population responses. The second topic is a consideration of relations between air pollution presence, perception, and subsequent moving behavior, controlling for the character of urban neighborhoods. The final section deals with the relevance of individual action to air pollution control programs.

The Salience of Hazards for Complaints

The nature of complaint activity.--Air pollution, along with the natural hazards of fire, flood, and slide, sometimes leads to disasters. Smog conditions have resulted in disasters in London in 1873, 1891, 1948, 1952, 1956, and 1962; in Glasgow, Scotland in 1909; in Manchester and Salford, England in 1930; the Meuse Valley of Belgium in 1930; and Donora, Pennsylvania in 1948.[9] Excess mortality during these disasters has been estimated at more than 8,000 deaths, with 4,000 deaths alone attributed to the London fog of December 5-8, 1952.[10] These data probably underestimate smog related deaths from pulmonary, cardiovascular and other diseases. There is no doubt that air pollution is a disaster threat to the American population that could have as serious effects as the 1952 London fog did in the United Kingdom.

Reactions to such uncertain threats as air pollution depend on the symbolic environments urban populations utilize to describe the hazards involved.[11] Furthermore, strength of reaction to possible disaster reflects the amount of warning information that is interpreted.[12] Population tendencies under "normal" conditions are to predict favorable events with a higher probability than unfavorable ones.[13] For example, the passive attitude of the American population towards civil defense is associated with beliefs in the low probability of attack, adequate defenses, and a secure habitat.[14] This tendency is magnified with relation to smog since few individuals can take actions to alleviate the tensions and discomforts associated with high air pollution exposure levels. Confronted with signs of uncertain threats, some urbanites nevertheless undertake actions to ameliorate hazards. In Los Angeles County, there may be as many as five thousand annual complaints made to the Air Pollution Control District.[15] Approximately 1,500 or 30 per cent of these complaints are evaluated by the District's Enforcement Division.

Desired and implemented complaints.--While the previous chapter indicated clear relationships between hazard realities and perceptions, it is now necessary to determine the hazard contexts associated with overt population responses. There may be clear distinctions between perceptions and actions regarding hazards, similar to the previously described distinctions between hazard reality and perception. It is assumed that the necessary conditions for actions concerning hazards comprise perceptions of environmental contexts. Sufficient and activating conditions appear to consist of hazard presence *per se*, and their perceived impingement on the immediate lives of individuals. Metropolitan environmental hazards do not constitute an immediate threat to most metropolitan residents, and are generally localized in their effects. It was assumed that the amount of implemented complaint activity would vary directly with the perceived immediacy of hazards, and with population awareness of the availability of hazard abatement agencies whose function it is to take action regarding the perceived hazards. Of the considered hazards, brush fires, slides, and flood are more immediate and dramatic threats to residents of affected areas than are the ambient conditions of smog and air traffic noise.

Therefore, brush fires, slides, and floods are expected to be more salient for potential complaint behavior.

Data concerning complaint activity were obtained in July of 1962 for an area probability sample of all housing unit residents of the Los Angeles metropolitan area (including both Los Angeles and Orange Counties), then occupying units that were part of the 1961 housing inventory.[16] This sample represents 824 or 87.8 per cent of the randomly selected adult housing unit residents.

Respondents for 1962 were asked whether they considered contagious diseases, juvenile delinquency, unemployment, smog, brush fire, earth slides, floods, traffic noise, traffic congestion, and airplane noise to be problems in their neighborhoods.[17] In contrast to these perception measures, reports of subsequent complaints were taken as indices of the importance of hazard perception for action. "Active complainers" were defined as respondents reporting that they wished to complain about social or environmental hazards, and then carried out such wishes; "passive complainers" stated they wished to complain but did not take action.[18] "Potential complainers" comprised the sum of the active and passive complainer categories.

Figure 9 shows the percentages of total respondents

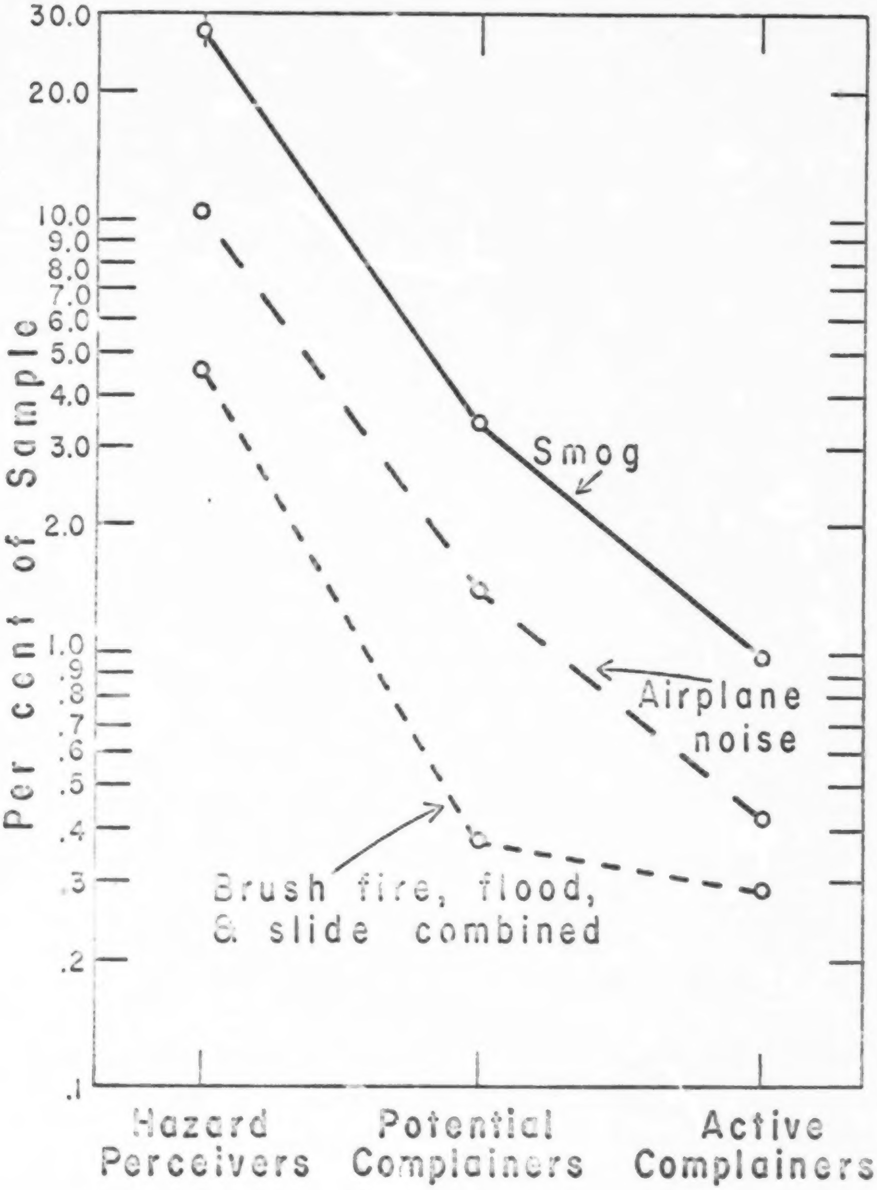

Figure 9---Per cent of hazard perceivers, potential complainers, and active complainers among the total respondents, June 1962.

who perceived the hazards of smog, and air traffic noise; and brush fires, flood, and slide combined for 1962, and who were potential or active complainers. Air pollution was the hazard most frequently perceived; and, it was also associated with the largest population of potential and active complainers. The connecting slopes between hazard perceivers and potential complainers indicate that perception is more crucial for potential complaints concerning the artificial hazards of smog and air traffic noise than for the combined natural hazards of fire, flood, and slide. Approximately 12 per cent of the smog and air traffic noise perceivers were classified as potential complainers, as compared with approximately 8 per cent of the fire, slide, or flood perceivers. This may be explained on the basis that both smog and air traffic noise are more frequently encountered than the more dramatic hazards of fire, flood, and slide. On the other hand, Figure 9 indicates that potential complainers are less likely to take action regarding air pollution and air traffic noise than are potential complainers for fire, floods, or slide. For smog and air traffic noise, respectively, approximately 31 and 17 per cent of the potential complainers became active complainers, as compared with a mean of 78 per cent of the combined potential complainers for fire, slide, and flood.

Perception of artificial hazards has more salience for potential complaints than perceptions of natural hazards, but potential complaints regarding natural hazards have more salience than for environmental hazards. The reservoir of the smog and air traffic noise perceiving populations is only one-half as likely to engage in complaint activity as is the natural hazard perceiving population. Active complainers for any single hazard or combination of hazards, however, comprise a small segment of the total metropolitan area sample. Only one per cent of the sample reported making active smog complaints, one-half of one per cent specified active air traffic noise complaints, and a mean of three-tenths of one per cent indicated active brush fire, flood or slide complaints.

Table 19 shows the distribution of potential, passive, and active complainers for a range of social and environmental hazards. Juvenile delinquency yielded the largest number of potential complainers, and air pollution was the next most important source of potential complainers. Of the potential complainers concerning delinquency and smog, a statistically significant larger percentage complained about delinquency. Perception of immediate hazards such as

TABLE 19

DISTRIBUTION OF PROBLEMS ABOUT WHICH RESPONDENTS WISH TO COMPLAIN LOS ANGELES STANDARD METROPOLITAN AREA SAMPLE: 1962

Complainer Type	Smog		Disease, Unemployment		Juvenile Delinquency		Fires, Slides, Floods		Traffic		Air Traffic Noise		Other Hazards	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Active Complainers	8	30.8	1	25.0	25	58.1	7	77.7	7	41.2	2	16.7	9	42.9
Passive Complainers	18	69.2	3	75.0	18	41.9	2	22.3	10	58.8	10	83.3	12	57.1
Potential Complainers	26	100.0	4	100.0	43	100.0	9	100.0	17	100.0	12	100.0	21	100.0

juvenile delinquency, brush fires, floods, and earth slides is reported as more closely linked to subsequent action than are such relatively common states as air pollution and air traffic noise. The greater salience of juvenile delinquency, brush fires, and floods, and slides likely reflects the presence of personalized warning information, the visibility of urban institutions which deal with them (i.e., fire and police departments), and the fact that such hazards represent an unusual condition. Implemented complaint activity varies directly with the immediacy of hazards, and is possibly associated with the perceived presence of hazard abatement agencies. Smog and air traffic noise perceiving populations take relatively little action in reference to these stimuli.

Environmental and social psychological determinants of complaints.--An examination was made of relationships of environmental and social psychological characteristics related to complaint activity. Data were analyzed concerning the presence or absence of smog in the residential areas of the complainers; the relation of neighborhood satisfaction and anomie or lack of norms (as measured by Srole's anomie scale), with respect to taking action concerning complaint choices; and the kinds of explanations given by potential complainers for not taking action. It was expected that active complaint activity would reflect the reality of hazards in neighborhood of residence, and that there would be a tendency for residents of smog areas to be active complainers concerning smog instead of other environmental hazards.[19] Table 20 shows a statistically significant relation between neighborhood smog reality and complaint activity; almost four-fifths of the smog complaints were made by residents of smog areas.[20] A smaller percentage of complainers living in areas with negligible smog complained about smog than those complainers residing in areas with air pollution. When the residence locations of smog complainers were plotted on a metropolitan area map, complainers were found to reside in central Los Angeles and in other heavy smog areas.[21] Juvenile delinquency complainers showed no similar pattern of concentration in high rate areas of juvenile delinquency.[22] While air pollution is not highly salient for active complaints, smog complaints that occur in the metropolis are made by populations that largely reside in pollution areas.

Air pollution complaint activity, like perception, is not necessarily inversely related to favorable neighborhood

TABLE 20

RESIDENTIAL DISTRIBUTION OF COMPLAINERS
LOS ANGELES STANDARD METROPOLITAN AREA SAMPLE: 1960

Type of Complaint	Smog Area Residents		Not Smog Area Residents		Total	
	No.	%	No.	%	No.	%
Smog	20	28.6	6	9.7	26	19.7
Other problem	50	71.4	56	90.3	106	80.3
Total	70	100.0	62	100.0	132	100.0

evaluations. A commitment to place as evidence by neighborhood satisfaction, can lead to protective reactions to impersonal environmental threats. When neighborhood evaluations of smog and juvenile delinquency complainers were compared, as shown in Table 21, it was found that active smog complainers were significantly more satisfied with their neighborhoods of residence than were active juvenile delinquency complainers.[23]

In addition to the presence or absence of air pollution, and neighborhood evaluation, commitment to a middle class normative structure was examined as a factor differentiating between juvenile delinquency or smog complaint choices. Respondent anomie types,[24] were compared with complaint choices. A chi square test for data not shown indicated no relation between anomie type and complaint choice. These data were re-examined to determine if there was an association between being a passive complainer (one who wishes to complain but does not) and anomie. Chi square tests were made with respect to anomie and smog, anomie and delinquency complaints, and all other complaints. No significant associations were found, thus there was no evidence that passive complainers are more anomic than active ones. Anomie type placement was not related to the actions of

TABLE 21

COMPLAINT CHOICE AND NEIGHBORHOOD EVALUATION LOS ANGELES STANDARD METROPOLITAN AREA SAMPLE: 1962

Complaint Choice	Neighborhood Evaluation			
	Satisfied		Dissatisfied	
	No.	%	No.	%
Smog	24	47.1	2	11.1
Juvenile Delinquency	27	52.9	16	88.9
Total	51	100.0	18	100.0

potential complainers.

A further examination was made to determine whether complaint activity was related to respondent perceptiveness of hazards, as measured by responses on the county environmental hazard perception scale.[25] Table 22 indicates that there was no relationship either between a desire to complain about smog or the act of complaining and hazard perceptiveness. This relationship was examined by introducing two control variables, respondent education[26] and date of settlement[27] of area of residence. The analysis revealed that date of settlement was related to the desire to complain and to hazard perceptiveness. Table 23 shows that respondents living in areas settled prior to 1950 who had high hazard perception scores for all hazards scale scores wished to complain. Education did not influence the relationship between the desire to complain and hazard perception.

Passive complainers.--Active complainers concerning air pollution appear to perceive smog realistically; their complaint activity may be interpreted as a defense of neighborhood and not as disorganized or anomic behavior. Most potential complainers, however, were passive, and did not take action with reference to air pollution. Why was no

TABLE 22

RELATIONSHIP BETWEEN GUTTMAN SCALE OF PERCEPTION OF ENVIRONMENTAL HAZARDS AND COMPLAINTS LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA SAMPLE: 1962

Variable	X^2 (1 d.f.)	Significance .05
Desire to Complain	1.49	N.S.
Act of Complaining	.26	N.S.

TABLE 23

COMPLAINER VARIABLES-PERCEPTION CONTROLLING FOR EDUCATION AND DATE OF SETTLEMENT: LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA SAMPLE: 1962

Control Variable	Complainer Variable	Interaction Direction .05
Education	Desire to Complain X Perception	No
	Act of Complaining X Perception	No
Date of Settlement	Desire to Complain X Perception	Yes--Old Area Complainers Perceive Smog
	Act of Complaining X Perception	No

action taken?[28] Seventeen of the eighteen passive complainers indicated a sense of hopelessness when coping with air pollution on this level. Typical responses were "there is no sense to complain, it wouldn't do any good," or "there is no one to whom one can complain." Reasons for not complaining about juvenile delinquency stood in sharp contrast. Passive delinquency complainers explained their activity in terms of personal neglect or other reasons, and only a few respondents gave "hopeless" responses. Anomie is not related to active or passive air pollution complaint activity. The analysis of reasons for not complaining, does however, emphasize a sense of frustration for potential smog complainers.

The small numbers of potential smog complainers who implemented their desires, suggests that smog perceivers felt it was a problem over which they had little personal influence. More than fifteen per cent of the total metropolitan population apparently believes smog is a serious problem in their neighborhoods, but they did not take action to alleviate their concern. This passive response pattern suggests that the metropolitan population has not conceptualized how complaints or action could alleviate air pollution. Continuing threats of air pollution, and a lack of adaptable air pollution defenses for individuals are likely to lead to similar impotent smog responses in the future.[29] Disaster research formulations suggest that urbanites with such constraining threats are likely to have low sensitivity to hazard information yet have a high level of tension concerning the potential consequences of impure air.[30] On the other hand, living in air pollution areas is related to smog perception and the desire to actively complain. Furthermore, awareness of smog also influences smog perception. The initiation of a complaint is related to the characteristics of the problem; that is, populations must not only crystallize their perceptions but also know what to do about them. The positive relation of neighborhood satisfaction to the choice of air pollution complaint activity lends support to this assumption since neighborhood satisfaction is directly related to smog perception.

The analysis of the salience of hazards for complaints suggests that actions regarding air pollution are blocked because hazard perceivers do not use communications channels to hazard abatement agencies. Individuals able to implement complaint desires are likely to reside in air pollution areas and may well have realistic concerns about neighborhood preservation. Hazard perceivers who do not take action comprise an important source of potential residential dissatisfaction within the metropolis. A lack of knowledge of avenues for solution to specific air pollution problems may lead residents of affected areas to give credence to simplified and unrealistic approaches to control, and thus impede the effectiveness of existing smog abatement agencies. At the same time, smog perceiving populations likely constitutes an effective resource for air hazard control programs, if they can be drawn more into communication with agencies concerned with air pollution abatement.

Smog and Residential Mobility

Of the five environmental hazards studied, air pollution was the most widely perceived in Los Angeles in 1962 and the most salient for potential complaints, but had low salience for subsequent complaint activity. Feelings of hopelessness concerning the effectiveness of complaint activity were expressed by potential smog complainers who did not implement their desires. As these persons comprise a small portion of hazard perceiving Angelenos, their discontent may have little influence on control programs. The question remains as to whether air hazard perception, and residence in affected sites are factors which generate moving behavior.

An analysis of residential mobility which will resolve this issue is beyond the scope of this research. It was shown in Chapter IV that air pollution was not an important factor in total population redistribution from 1950 to 1960 between areas at different stages of housing development within successive distance rings from the Los Angeles Civic Center.[31] The index of population redistribution there used was based on total population change; including fertility, mortality, in-migration, and out-migration. On the individual level, however, mobility may be viewed as having social psychological determinants, which operate within a matrix of demographic and ecological factors relevant to population redistribution. Family, occupation, neighborhood, and residence here appear to be associated closely with subsequent moves of metropolitan residents.[32] The structure of the family, as represented by the family life cycle, has a social psychological component of familism; occupational and social mobility has a component of social mobility expectations; and characteristics of residence and neighborhood are expressed and reflected in locality participation and residential needs and aspirations. Furthermore, choices to move from or to stay at particular places of residence, while influenced by past mobility experiences, effectively discriminate between mobile and stable populations.[33]

The present consideration of residential mobility is limited to neighborhood characteristics and perceptions, plans and choices to stay or to move, and subsequent mobility or stability for a sample first interviewed in July 1961, and then monitored for a one year period.[34] Plans and choices to move or stay, and subsequent mobility are compared for residents of smog and non-smog areas at different stages of the urban housing cycle for populations who perceive or do not perceive air hazards in their neighborhoods. No attempt is made to specify, in comparison with other mobility determinents, the relative contributions of air pollution reality and perception to subsequent residential mobility. The question that can be answered is whether air hazard perceivers, and residents of affected sites, are more likely to resolve concerns about impure air by subsequently moving than are non perceivers and residents of hazard free areas.

Measurement of mobility, smog perception, neighborhood smog, and date of settlement.--The criterion index of one year subsequent mobility was constructed from data obtained in the Los Angeles-Orange County area probability sample with respect to those respondents who had moved from July 1961 to July 1962.[35] All respondents alive in July 1962 were classified as "movers" or "non-movers" according to whether their place of residence in July 1962 was the same or different from their place of residence in July 1961. Planned and choice mobility status were obtained from the respondents at the time of the July 1961 interviews. For "autonomous" families and individuals, residential plans may flow from a priori choices. Choice, however, may have little influence on subsequent behavior when individuals and households have limited resources and locational opportunities, or desired residences are lacking.[36] Respondents were classified as "planned movers" or "planned stayers" according to answers to a question requesting intentions to move from or to stay at their present places of residence in the following twelve month period.[37] "Choice movers" and "choice stayers" indicated a desire to stay or to move, respectively.[38] The reliability and validity of the choice and plan mobility status classifications was impaired by the use of single variable indexes. Furthermore, information was not available as to whether the movers from 1961 to 1962 changed to neighborhoods with air pollution or which were free from air hazards.[39]

Smog perception data for the 1961 Los Angeles-Orange

County area probability sample were obtained prior to the time that the panel implemented plans and choices to move from or to stay at their particular places of residence.[40] "Reality" of air pollution was based on physical measures imputed to the July 1961 neighborhood of residence, as described in Chapter III[41] while perception is based on July 1961 individual responses concerning whether or not smog was perceived. The housing cycle for residence neighborhoods was described in terms of the date of settlement index developed in Chapter IV,[42] with census tract areas classified as having "built up" to a density of two dwelling units per gross acre prior to 1940, from 1940 to 1950, from 1950 to 1960, or not built up by 1960.

Within limits of the above data, the 1961 Los Angeles and Orange County sample reflects subsequent mobility, plans and choices to move, and the perception and reality of air pollution for the housing unit population of the metropolis living in residence areas at different stages of the urban housing cycle.

Mobility plans, choices, and behavior in smog areas and smog free areas.--As is indicated in Table 24, 1961-1962 rates of planned, choice, and subsequent mobility for the

TABLE 24

MOBILITY PLANS, CHOICES AND BEHAVIOR IN SMOG AND NON-SMOG AREAS, LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA: 1961-1962

Plan	Choice	No.	% of Total	% Movers	% Anticipating Behavior	% Fulfilling Choice
			(979)		Total	
--	--	979	100.0	22.9	77.8	66.4
Move	--	295	30.1	51.2	51.2	56.6
Stay	--	684	69.9	10.7	89.3	70.6
--	Move	421	43.0	37.5	67.9	37.5
--	Stay	558	57.0	11.8	85.3	88.2
Move	Move	235	24.0	54.9	54.9	54.9
Move	Stay	60	6.1	36.7	36.7	63.3
Stay	Move	186	19.0	15.6	84.4	15.6
Stay	Stay	498	50.9	8.8	91.2	91.2
			(476)		Absent	
--	--	476	100.0	21.0	80.7	70.0
Move	--	124	26.0	53.2	53.2	56.4
Stay	--	352	74.0	9.7	90.3	74.7
--	Move	189	39.7	38.6	67.7	38.6
--	Stay	287	60.3	9.4	89.2	90.6
Move	Move	98	20.6	56.1	56.1	56.1
Move	Stay	26	5.4	42.3	42.3	57.7
Stay	Move	91	19.1	19.8	80.2	19.8
Stay	Stay	261	54.9	6.1	93.9	93.9
			(503)		Present	
--	--	503	100.0	24.6	75.1	63.0
Move	--	171	34.0	49.7	49.7	56.7
Stay	--	332	66.0	11.7	88.3	66.3
--	Move	232	46.1	36.6	68.1	36.6
--	Stay	271	53.9	14.4	81.2	85.6
Move	Move	137	27.3	54.0	54.0	54.0
Move	Stay	34	6.7	32.4	32.4	67.6
Stay	Move	95	18.9	11.6	88.4	11.6
Stay	Stay	237	47.1	11.8	88.2	88.2

Los Angeles sample were constructed for areas with and without air hazards,[43] for all of the 979 respondents surviving from July 1961 to July 1962. Comparisons of plans and choices with subsequent behavior, reflect the respondents predictions of subsequent mobility, and realization of mobility desiderata.[44] A comparison of agreement of July 1961 plans and subsequent behavior to July 1962 was used to classify panelists as "anticipated" or "unanticipated" movers and stayers. Mobility choice as of July 1961 as compared with subsequent behavior to July 1962 was used as a basis for defining mobility "fulfillment." These indexes reflect subsequent adjustment to residential needs and desires for the Los Angeles sample.

Table 24 shows a total subsequent mobility rate from 1961 to 1962 of 22.9 per cent, and comparable rates of 24.6 and 21.0 per cent in smog and non-smog areas, respectively. While proportionately more subsequent movers lived in smog than in non-smog areas in 1961, these subsequent mobility rate differentials were not statistically significant.[45] On the other hand, mobility plans and choices are important precursors of residential mobility in both smog and non-smog areas. In this case, plans are more important than choices in subsequent moves, and distinguish in combination for the total population, between a range of mobility rates from 54.9 to 8.8 per cent. A larger percentage of the smog area residents planned and/or chose to move than did residents of non-smog areas. Table 24 also shows the extent to which plans and choices to move from or to stay in their July 1961 neighborhoods were implemented by residents of smog and non-smog areas. Non-smog area residents in 1961 were more likely to fulfill their choices and anticipate their behavior than were residents of smog affected neighborhoods. Sixty-three per cent of the 1961 residents fulfilled their choices to stay or to move as contrasted with 70.0 per cent of non-smog area residents. Comparable percentages of the panel anticipating behavior were 75.1 and 80.7 per cent, respectively. Furthermore, 56.3 per cent of the smog area residents were able to subsequently both fulfill choices and anticipate behavior, a statistically significant difference when compared to 63.0 per cent of the residents of smog free areas.[46] Choosing to move yet subsequently remaining in residence areas constitutes a source of residential discontent that is statistically more important in air hazard neighborhoods than in neighborhoods with clean air.[47] Among respondents remaining in smog areas from 1961 to 1962, 38.8 per cent had wanted to move but had not fulfilled their choices. The comparable percentage for stayers in non-smog areas was 30.9 per cent.

The above differences, while relatively slight, are consistent. Residents of smog areas are more likely to plan and/or choose to move, and to subsequently move, but less likely to anticipate future residence situations or meet residence desires than are residents of clean air areas. Furthermore, residential dissatisfaction defined as resulting from thwarted mobility choices is more likely to be found in smog than in non-smog areas. The origin of these differences, however, does not necessarily lie in smog. It has been previously shown that air pollution strongly affects areas at the last stages of the housing cycle. These neighborhoods may have disproportionate numbers of lower social economic status residents without resources to implement their desires to move. Smog may be a "push" function in residential changes, but the friction imposed by circumstances may impede its effectiveness as a generator of mobility. Nevertheless, within the framework of the measures utilized, residents of air pollution affected sites are more likely to express mobility related attitudes than are residents of areas without air pollution.

Smog reality, perception, the urban housing cycle, and subsequent residential mobility. Table 25 summarizes relations between the reality and perception of smog, residence in smog areas, age of neighborhood, and subsequent residential mobility. The 1961 to 1962 mobility rate for smog perceivers was 26.8 per cent, contrasted with 17.2 per cent for non-perceivers of air hazards, a difference which was statistically significant.[48] Mobility rates for air hazard perceivers and non perceivers in smog areas were 28.2 and 14.9 per cent respectively, and comparable rates for residents of smog free areas were 24.3 and 18.3 per cent. The smog perception-subsequent mobility relationship was significant for residents of smog areas,[49] but not for residents of areas without smog.[50] Differences in significance were here interpreted as meaning the residence in a smog area influenced the perception-mobility relationship, with smog area residents being more likely to move than residents of areas without smog.

Detailed tabulations in Table 25 show the influence of smog perception upon subsequent mobility in smog and smog free areas, within each date of settlement cohort of the urban housing cycle. There is an increase in residential mobility rates with an increase in the age of neighborhoods

TABLE 25

RELATIONS OF SMOG REALITY, PERCEPTION, AND SUBSEQUENT RESIDENTIAL MOBILITY BY URBAN HOUSING CYCLE STAGES, LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA: 1961-1962

Date of Settlement	Neighborhood Smog	Total		Smog Perceivers		Smog Non-Perceivers	
		N	% Movers	N	% Movers	N	% Movers
Total	Total	979	22.9	583	26.8	396	17.2
	Present	503	24.6	369	28.2	134	14.9
	Absent	476	21.0	214	24.3	262	18.3
Prior 1940	Total	350	27.1	230	29.1	120	23.3
	Present	243	27.6	184	29.9	59	20.3
	Absent	106	26.2	46	26.1	61	26.2
1940-1950	Total	171	24.1	111	27.9	60	18.3
	Present	69	26.1	57	31.6	12	.0
	Absent	102	23.5	54	24.1	48	22.9
1950-1960	Total	261	21.8	153	27.4	108	13.9
	Present	119	21.0	84	25.0	35	11.4
	Absent	142	22.5	69	30.4	73	15.1
1960+	Total	197	15.2	89	18.0	108	13.0
	Present	72	19.4	44	22.7	28	14.3
	Absent	125	12.8	45	13.3	90	12.5

in Los Angeles and Orange Counties. This pattern is consistent with the findings concerning population redistribution from 1950 to 1960 for Los Angeles County reported in Chapter IV.[51] It was seen that population growth favored newer date of settlement areas, and that little or no growth was occurring in the older neighborhood cohorts. While data were not available concerning the destination of intra-metropolitan movers, the direct relationship between mobility rates and age of housing of residence areas, suggests a movement of population from older to newer neighborhoods. Furthermore, with the exception of the 1950-1960 date of settlement cohort, there are slightly higher subsequent mobility rates from smog than from non-smog areas. While these differences are small, they do suggest that smog area residents have consistently greater propensities to move than do residents of smog free areas.

Disregarding the presence or absence of smog, within each date of settlement area, there are higher subsequent mobility rates for smog perceiving than for non-perceiving populations. While these differences are not statistically significant and number of cases for more detailed comparison are limited, subsequent mobility rates are higher among smog perceiving than non-perceiving populations among residents of seven of eight date of settlement and air pollution status areas. The one exception is for residents of non-smog areas settled prior to 1940, where subsequent mobility rates of smog perceivers and non-perceivers were effectively the same. On the other hand, subsequent mobility rates indicative of out-mobility from smog areas appear to depend on the perception of smog. There were higher subsequent mobility rates for non-smog than for smog areas for the non-smog perceiving population of the cohorts settled prior to 1940, in the 1940's, and in the 1950's, as well as among the smog perceiving population of the 1950's cohort. Furthermore, date of settlement is not directly related to subsequent mobility for smog perceiving and non-perceiving residents of areas with or without air pollution.

The above differences show that air pollution perception more consistently differentiates subsequent residential mobility than does the presence of pollution or the stage of the area of residence within the urban housing cycle. An examination of the rates in Table 25 suggests that with respect to their association with subsequent mobility, perception is more important than smog reality and date of settlement, while date of settlement is more important than smog reality. It was assumed that the relationships here found were not due to a differential concentration of smog perceiving populations in air pollution areas at earlier stages of the urban housing cycle. To test this assumption, a comparison was made of the observed mobility rates for the smog perceiving and non-perceiving population with the expected residential mobility rates that would obtain if both populations were distributed as the total population with respect to air pollution reality and date of settlement.[52] Table 26 shows the results of these comparisons. Date of settlement and residence in smog areas account for less than 4 per cent of the total difference in mobility rates between smog perceiving and non-perceiving populations. The rate differences between perceivers and non-perceivers are not due to these factors.

A further analysis was made of the disparity between desired and perceived current neighborhood characteristics with respect to smog, as these factors may have influenced observed 1961-1962 residential mobility. Disparity was measured by neighborhood discrepancy index as obtained for 1961; this index summarized differences between what respondents wanted in the way of freedom from air pollution at the time of the move to their 1961 neighborhood of residence and what they perceived their current neighborhood

TABLE 26

OBSERVED AND EXPECTED SUBSEQUENT MOBILITY RATES, SMOG PERCEIVERS AND NON-PERCEIVERS, CONTROLLING FOR INFLUENCE OF DATE OF SETTLEMENT AND PRESENCE OF SMOG, LOS ANGELES STANDARD METROPOLITAN STATISTICAL AREA: 1961-1962

Category	Smog Perceivers	Smog Non-Perceivers	Difference
(1) Observed %	26.8	17.2	9.6
(2) Expected %	25.8	16.5	9.3
(3) Influence of date of settlement and smog: (1)-(2)	1.0	.7	.3

to be like with respect to smog at the time of the 1961 interview.[53] A discrepancy index with respect to smog was obtained by summing, without regard to sign, the difference between current and desired responses. Scores on the discrepancy index varied for individual respondents from zero to two. The following discrepancy index values were observed: movers, 1.12; non-movers, .96; planned movers, 1.22; unplanned movers, .98; planned non-movers, 1.03; and unplanned non-movers, .94. Discrepancies between desired and perceived neighborhood characteristics were positively associated with plans to move and subsequent mobility. These differences, however, were slight and do not appear to make an important contribution to mobility.

The analysis of the relation between smog and residential mobility yielded consistent results. There was not a statistically significant relationship between moving behavior and the reality of smog. Regardless of smog reality, however, smog perceivers were significantly more likely to move than non-perceivers. Smog perceivers who were residents of smog areas were significantly more likely to move than non-perceivers, but a similar difference was not found for residents of areas without smog. Therefore, perception of the environment appears to be an intervening variable in the decision to move, and the real environment apparently has less importance. Perception is the key variable in this relationship, and consistently differentiates between movers and non-movers, even when the stages of the urban housing cycle are controlled.

Individual Action and Pollution Control Programs

Recognition of environmental hazards has implications for individual action. The presence of a hazard is not a sufficient condition for its recognition. In many cases, recognition that a hazard, such as air pollution exists, must be learned. That is, the individuals concerned must have the presence of smog pointed out to them before they can recognize it. This in turn, is closely related to the fact that recorded levels of air pollution are subject to the public's awareness of the problem. Air pollution monitoring stations are frequently located in areas where there is an expressed public concern over the air quality.

Once having recognized the presence of air pollution, the effects of it can be demonstrated to the individual. Aside from overt physical symptoms, other factors associated with air pollution such as the economic and physical well-being of the population may have to be identified before an immediate concern over the problem is manifested. The issue is to define the ambient nature of air pollution to the population in more certain and personal terms. Other detrimental effects of smog and their relevance to the lives of individuals can be publicized. It can be emphasized that segments of the population already burdened with problems associated with social disorganization, and who may be more helpless to do anything about them, are also more exposed to air pollution. Health programs can show that air pollution, if not directly a cause of illness, can be thought of as an aggravating condition.

It has also been stated that even after a hazard is perceived and its effects identified there is another necessary condition for taking action in relation to it which refers to the context in which the hazard occurs. For example, while juvenile delinquency and smog are both seen as a basis for making complaints, the lack of urban institutions which can serve as a focus for action regarding smog leads to expressions of hopelessness, and results in little overt behavior. There is no evidence that the population characterized by this feeling of hopelessness concerning smog is in any way disorganized or anomic. In other words, the "hopeless" non-complainers are likely to be well-adjusted individuals who correctly perceive that individual action may have little effect on their problem. Unless a community has a well defined institution or agency that is the focus of air pollution complaint activity, dissatisfaction with impure air will not lead to remedial action.

General warnings by public officials make little contribution to smog abatement, and only make the uncertain threat of air pollution appear to be more of a reality. In fact, such warnings may lead to public unrest if no official action is then taken. The only function of such activity is to activate pre-existing communications channels concerning air pollution. Air pollution is a national problem, as contaminated airsheds often overlap state boundaries. Interstate air hazard abatement activity is necessary for pollution control. Such programs, however, are likely to have little effect, if mechanisms for local population involvement are not built into the control systems. While large numbers of highly visible smog abatement personnel are not necessary for metropolitan smog control, there is a need to define control in such a manner that concerned populations can voice their problems to persons to whom they can relate on the local level. In this respect, police and fire officers who are traditional symbols of community authority, could perhaps play a mediating role in complaint activity. Unless some effective technique for relating smog concerned populations to local officials is developed, there are likely to be public reactions against air pollution control programs which do not allow for individual participation.

These comments are not to depreciate the role of the federal government in the control of environmental hazards. The coalescence of urban populations across state boundaries requires integrated planning at all government levels, and systems approaches that focus on total metropolitan ecological dynamics. The federal government can provide continuity between control programs that operate at different governmental levels. This continuity could well include the development of legislation that would facilitate communication of hazard perceiving populations with local agencies that are highly visible and which are traditionally viewed as mediating the complaints of citizens of the metropolis.

Footnotes

Chapter VI

[1] National Society for Clean Air, *Clean Air Yearbook: 1965-1966*, London, 1965, p. 44.

[2] John Evelyn, *Fumifugium: Or the Inconvenience of the Aer and Smoake of London Dissapated*, reprinted (London: National Society for Clean Air, 1961), Forward, p. 2.

[3] National Society for Clean Air, *loc. cit.*

[4] *Ibid.*, pp. 44-45.

[5] See: *California Standards for Ambient Air Quality: Air Pollution and Smog* (Los Angeles: Air Pollution Foundation, 1960); and a history of the formulation of the standards described in *Air Conservation: The Report of the Air Conservation Commission of the American Association for the Advancement of Science*, Publication No. 80, of the American Association for the Advancement of Science (Washington, D.C., 1965), pp. 249-260.

[6] Robert L. Chass, "Extent to which Available Control Techniques have been Utilized by Communities (1) Los Angeles County," *Proceedings National Conference on Air Pollution*, (Washington, D.C., November 18-20, 1958, U.S. Department of Health, Education, and Welfare, Public Health Service, Public Health Service Publication No. 654, (Washington, D.C.: U.S. Government Printing Office, 1959).

[7] A cessation of automobile based air pollution in Los Angeles will not necessarily end air pollution problems. Leslie Chambers, "Relation of Vehicular Air Pollutants to Pollutants from Other Sources," *National Conference on Air Pollution Proceedings*, Washington, D.C., December 10-12, 1962, U.S. Department of Health, Education, and Welfare, Public Health Service, Division of Air Pollution, Public Health Service Publication No. 1022 (Washington, D.C.: U.S. Government Printing Office), pp. 49-54.

[8] See, John Kenneth Gailbreth, The Affluent Society (New York: Mentor Books the New American Library of World Literature, 1958). Some of the proposed techniques for eliminating air pollution in Los Angeles have included towering chimneys for industrial plants, elimination of the internal combustion engine, giant vacuum cleaners that will remove impure matter from the air, giant electric fans, cutting passes in the mountains surrounding the Los Angeles basin, etc. See, Victor Gruen, The Heart of our Cities, the Urban Crisis, Diagnosis and Cure (New York: Simon and Schuster, 1964), p. 95. There is little evidence that these solutions, even if practical, would lead to a return of clean air in Los Angeles. See Leslie Chambers, op. cit., pp. 49-54.

[9] National Society for Clean Air, op. cit., p. 44.

[10] Ibid.

[11] See, Stephen B. Withey, "Reaction to Uncertain Threat," Man and Society in Disaster, ed. George W. Baker and Dwight W. Chapman (New York: Basic Books, Inc., 1962), pp. 93-123.

[12] Ibid., p. 115.

[13] Ibid., p. 113.

[14] S. B. Withey, Some Factors Influencing Public Reactions to Civil Defense (Ann Arbor: University of Michigan, 1954).

[15] Obtained from internal reports, Los Angeles County Air Pollution Control District.

[16] The July 1962 environmental hazards sample consisted of "non-movers" occupying housing units vacated by "out-movers" from July 1961 to July 1962. The 1962 sample does not reflect units added to the housing stock of the metropolis between July 1961 and July 1962. Of the total of 981 housing units enumerated in the July 1961 sample, 43 were vacant in July 1962. Further details of the 1962 sample are specified in Chapter V, pp. 134-135.

[17] See Chapter III, page 169, footnote 31, for a description of the content and scoring of questions eliciting responses to these characteristics as problems.

[18] Passive complainers, met the following criteria: (1) they responded "yes" to the question "Have you ever wanted to complain to some authority or agency about one of the kinds of problems (contagious disease, juvenile delinquency, unemployment, air pollution or smog, brush fires, earth slides, floods, traffic noise, traffic congestion, air plane noise) which we have been discussing?" (2) They were able to describe a problem in response to a subsequent question "Which problem, or problems, have you wanted to complain about?" (3) They responded "no" to the question "Have you ever made a complaint about one of the problems?" Active complainers met criteria (1) and (2) above, but responded "no" or "can't recall" to the questions used to implement criterion (3) above, and were able to describe the same problem as indicated in (2) above, in response to the question "Which problem or problems, have you complained about?" Mr. W. E. Belleau, Jr., carried out the initial analysis of complaints reported in this chapter.

[19] Some of the active complainers concerning smog may have taken action regarding perceived smog in areas other than their neighborhoods of residence. The interview procedure used for classifying potential and active complainers did not yield information as to the objects of specific complaints.

[20] X^2 .05, 1 df = 3.84, X^2 observed = 7.42. See Chapter III, pp. 52-53, for descriptions of measurements of air pollution levels used to describe the reality of smog.

[21] Ibid. pp. 52-53.

[22] Data are here based on unpublished census tract delinquency rate tabulations for total population ten through seventeen years of age, for 1959 and 1960.

[23] Neighborhood evaluation was measured by a question concerning neighborhood satisfaction on the 1962 interview schedule. See Chapter V, footnote 22. X^2 .05, 1 df = 3.84, X^2 observed = 6.20.

[24] See Chapter V, p. 137 for a discussion of the measurement of anomie.

[25] The environmental hazard perception scale, derived according to the Connell technique of scale analysis was based on comprehensions of smog, brush fires, earth slides, and floods in the county of residence. See page 153 for a description of the scale.

[26] Education was dichotomized between respondents who had completed high school and those who had not.

[27] Date of settlement provides a control for past history of area of residence by indicating the time at which land passed into urban residential use. See Chapter IV, pp. 77-87. Date of settlement of residence areas to a density of two dwelling units per gross acre was dichotomized at areas settled prior to 1950, and settled and not settled by 1950.

[28] Reported reasons for passive complaints were coded according to the following categories: (1) "hopelessness" (see discussion above); (2) "neglect"--"I intend to complain, but just haven't gotten around to it"; (3) "activity"--"instead of complaining, it is better to do something about the problem"; (4) miscellaneous; and, (5) no response.

[29] See Stephen B. Withey, "Reaction to Uncertain Threat," *op. cit*., p. 114 ff. for illustrations of the point that continued threat and a failure of adoptation or defense should lead to greater constriction of cognition, rigidity of response, and diffuse and primitive forms of reaction.

[30] *Ibid*., p. 116, 118.

[31] See pp. 108-116.

[32] See, for example, Paul C. Glick, *American Families* (New York: John Wiley and Sons, Inc., 1957), p. 89; Calvin Goldscheider, Maurice D. Van Arsdol, Jr., and Georges Sabagh, "Residential Mobility of Older People," in James Birren, Clark Tibbets, and Sidney Spector, eds. *Patterns of Living Arrangements of Middle Aged and Older People* (Washington, D.C.: U.S. Government Printing Office) forthcoming; Henry Shryock, Jr., *Population Mobility within the*

United States, Community and Family Study Center (Chicago: University of Chicago Press, 1964); and Peter Rossi, *Why Families Move* (New York: The Free Press of Glencoe, 1955); for illustrative statements of how family, occupation, residence, neighborhood characteristics and attitudes are associated with mobility decisions and behavior.

[33] Maurice D. Van Arsdol, Jr., and Georges Sabagh, "Retrospective and Subsequent Metropolitan Residential Mobility," Salt Lake City, April 1965 Meetings of the Pacific Sociological Association.

[34] The ensuing discussion of residential mobility is based on data derived from the paper cited in footnote 32 above. See pp. 134-135 for a description of the July 1961 sample of Los Angeles and Orange County housing unit residents.

[35] Mobility status was determined by place of residence of respondents in July 1962, as compared with July 1961. Moves of respondents were attributed to their households. No record was made of interim moves, thus respondents moving and then returning to the July 1961 place of residence are classified as non-movers. The mobility rate is indicative of prevalence rather than incidence.

[36] For individuals, the effective housing market depends largely on the availability of finances, access to information sources that facilitate finding the "right dwelling in the right neighborhood," and the availability of housing of a type which is favorably defined. Rossi, *op. cit.*, pp. 152-172.

[37] "Planned movers" responded "uncertain," "no response," or stated "probably move" in response to the question "Do you plan to move from this place within the next year?" Planned stayers responded "definitely not move" or "probably not move."

[38] "Choice movers" responded "move," "uncertain," or gave no response to the question, "If you had your choice, would you stay here or move?" "Choice stayers" answered "stay" in response to this question.

[39] Data are available as to whether movers were intrametropolitan movers or migrants, but in the absence of information concerning specific destinations of moves, this classification was not included in the mobility analysis.

[40] Smog perceivers and non-perceivers were classified by responses to the question, "Would you say this neighborhood is free from smog?" with those responding "yes" classified as "non-perceivers" and all other respondents classified as "perceivers." This means of classifying smog perceivers is not comparable with that utilized with the 1962 area probability sample (see pp. 134-135).

[41] See pp. 51-70 for a description of non-air hazard data allocated to neighborhoods of residence.

[42] See pp. 77-91 for a discussion of measurement of the urban housing cycle.

[43] All planned, choice and subsequent mobility rates are expressed as percentages of the July 1961 interviewed population who survived to July 1962. A preferable base for computing 1961-1962 mobility rates would have been the final number of households at the end of the observation period minus all in moving households, plus out moving households who had moved into the area initially. (See Ralph Thomlinson, "The Determination of a Base Population for Computing Migration Rates," The Milbank Memorial Fund Quarterly, XL (July, 1962), pp. 356-366. Information was not available as to the number of housing units occupied by a comparable sample in July 1962.

[44] The differences in planned, choice and subsequent mobility rate levels shown in Table 24 indicate that, at both the aggregate and individual level, mobility plans, choices, and behavior, while positively associated, are not measures of the same phenomenon.

[45] $z_{.05}$, 1 tailed test = 1.60, z observed = 1.44.

[46] $z_{.05}$, 1 tailed test = 1.60, z observed = 2.31.

[47] $z_{.05}$, 1 tailed test = 1.60, z observed = 2.36.

[48] X^2 .05 1 df = 3.84, X^2 observed = 11.965.

[49] X^2 .05 1 df = 3.84, X^2 observed = 9.303.

[50] X^2 .05 1 df = 3.34, X^2 observed = .254.

[51] See, pp. 104-116.

[52] See S. L. Wolfbein and A. J. Jaffee, "Demographic Factors in Labor Force Growth," *American Sociological Review*, II, 392-396, for an example of the mode of analysis here utilized.

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